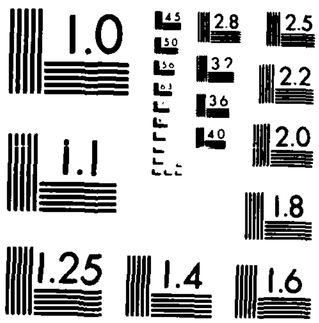
AD-A152 014 MANAGING RECOVERABLE AIRCRAFT COMPONENTS IN THE PPB (PLANNING PROGRAMMING..(U) RAND CORP SANTA MONICA CA J BIGELOW JUN 84 RAND/R-3094-MIL MDA903-81-C-0381 1/5

UNCLASSIFIED F/G 5/1 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A

Managing Recoverable Aircraft Components in the PPB and Related Processes

Technical Volume

James Bigelow

Rand

The research described in this report was sponsored by the Office of the Assistant Secretary of Defense, Manpower, Installations and Logistics under Contract MDA903-81-C-0381.

Library of Congress Cataloging in Publication Data

Bigelow, James, 1944-
Managing recoverable aircraft components in the PPB and related processes.

"Prepared for the Office of the Assistant Secretary of Defense (Manpower, Installations, and Logistics)"
"R-3093-MIL"—V. 1; "R-3094-MIL"—V. 2.
Contents: v. 1. Executive summary—v. 2. Technical volume.
1. United States—Armed Forces—Aviation supplies and stores—Management—Mathematical models. I. Rand Corporation. II. United States. Office of the Assistant Secretary of Defense (Manpower, Installations, and Logistics) III. Title.
UG1103.B54 1984 358.4'183 84-8388
ISBN 0-8330-0568-5 (v. 1)
ISBN 0-8330-0569-3 (v. 2)

Published by The Rand Corporation

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: R-3094-MIL	2. GOVT ACCESSION NO.: A152 014
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle): Managing Recoverable Aircraft Components in the PPB and Related Process: Technical Volume	5. TYPE OF REPORT & PERIOD COVERED: Interim
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): J. Bigelow	8. CONTRACT OR GRANT NUMBER(s): MDA903-81-C-0381
9. PERFORMING ORGANIZATION NAME AND ADDRESS: The Rand Corporation 1700 Main Street Santa Monica, CA 90406	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS: Manpower, Installations and Logistics Assistant Secretary of Defense Washington, DC 20301	12. REPORT DATE: June 1984
	13. NUMBER OF PAGES: 352
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report): Unclassified
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for Public Release; Distribution Unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

No Restrictions

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Aircraft Maintenance
Spare Parts
Planning Programming Budgeting
Logistics Management

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

see reverse side

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

This report describes a methodology called ORACLE--Oversight of Resources and Capability for Logistics Effectiveness. ORACLE's purpose is to assess the effects of varying certain resource levels on the peacetime materiel readiness and wartime sustainability of U.S. air forces, so that resource requirements can be better estimated and justified. It is intended primarily for use in the Planning, Programming, and Budgeting (PPB) process, but it can also be useful during execution. The author concludes that by itself, ORACLE should have significant value for resource planning. In conjunction with an improved forecasting capability and an execution tracking and control system, ORACLE's value will only be enhanced.

R-3094-MIL

Managing Recoverable Aircraft Components in the PPB and Related Processes

Technical Volume

James Bigelow

June 1984

Prepared for the
Office of the Assistant Secretary of Defense/
Manpower, Installations and Logistics

Rand
1700 MAIN STREET
P.O. BOX 2138
SANTA MONICA, CA 90406-2138

PREFACE

Current defense research at Rand includes wartime capability assessment, with special attention to the relationship between support resources and capability. Much of this work is geared toward understanding the Planning, Programming, and Budgeting (PPB) process, and how it is connected with day-to-day management processes, from a systems point of view.

This report describes a methodology developed as part of the work: ORACLE--Oversight of Resources And Capability for Logistics Effectiveness. It is one of two volumes prepared as final documentation of the study effort "Assessing the Peacetime Material Readiness and Wartime Sustainability of U.S. Air Forces," sponsored by the Office of the Assistant Secretary of Defense (Manpower, Installations and Logistics) under Contract No. MDA903-81-C-0381. The volumes have the general title *Managing Recoverable Aircraft Components in PPB and Related Processes*. The present report, focusing on technical details, is intended for readers who may wish to implement or extend this methodology, or to understand its technical limitations. The companion report is an executive summary of the study.

SUMMARY

S.1. INTRODUCTION

This report describes a methodology called ORACLE--Oversight of Resources And Capability for Logistics Effectiveness. ORACLE's purpose is to assess the effects of varying certain resource levels on the peacetime materiel readiness and wartime sustainability of U.S. air forces, so that resource requirements can be better estimated and justified. Peacetime materiel readiness and wartime sustainability are among the general goals established in the Planning, Programming, and Budgeting (PPB) process, which then translates the goals into a five-year program of activities and capabilities and puts together a detailed budget for the first year of the program. Then the execution process uses the budgeted dollars to carry out the program. ORACLE is intended primarily for use in the PPB process, but we feel it can also be useful during execution. We have built a prototype of ORACLE that deals with requirements to buy and repair recoverable aircraft components (e.g., components that can be repaired, such as guns, radars, and landing gear). The prototype reflects Air Force data and procedures, but the methodology, suitably modified, could also be useful in a Naval Air Forces context.

To help manage approximately 150,000 aircraft components during execution, the Air Force Logistics Command (AFLC) uses the D041 system [1]. Each quarter, D041 estimates how many of each component must be bought and repaired in each of ten to 13 future quarters to support the program. Because item managers (here, "item" is synonymous with "component") base their day-to-day decisions in large part on these estimates, dollar requirements used in the PPB process should be consistent with the D041 estimates. Indeed, persuant to a DoD instruction [2], the dollar totals used in the PPB process are D041 estimates accumulated across components. In the Navy, the Aviation Supply Office (ASO) has a similar system to help them manage approximately 64,000 components. The LEVELS [3] program estimates buy requirements for individual components, and STRAT [4] accumulates

requirements to obtain dollar figures for the PPB system. ASO also has programs to estimate repair requirements, both for individual components and in aggregate form. (For simplicity, however, we will hereafter refer to the Navy system as LEVELS/STRAT and omit mention of the programs that estimate repair requirements, even though the ORACLE methodology encompasses both buy and repair requirements.) Both D041 and LEVELS/STRAT are so large and cumbersome that only one program can be investigated each time they are exercised. The PPB process, however, must consider many different programs and their resource implications. Moreover, both D041 and LEVELS/STRAT change frequently,[1] and requirements estimates used in the PPB process must be updated to remain consistent.

S.2. THE ORACLE METHODOLOGY

The ORACLE methodology constructs an aggregate database as an additional product of the standard D041 quarterly exercise (or the LEVELS/STRAT exercise). The database thus reflects all changes in D041 or LEVELS/STRAT data or methodology that have occurred since the previous exercise. This database is small enough to fit in a portable microcomputer and can be rapidly manipulated by a spread-sheet-like program to "mimic," in aggregate form, the responses of the D041 or LEVELS/STRAT system to program changes. The ORACLE database is aggregated, so its user can estimate dollar requirements for any desired group of components rather than individual component requirements.

D041 develops the net buy and repair requirements for a component by first building the gross requirement from a variety of individual pieces and then subtracting different types of assets until either the assets or the requirement is exhausted. The pieces that make up the

---

[1]Component data (e.g., assets, demand rates) are updated during each exercise. Also, AFLC is currently modifying the D041 methodology. D041 currently bases its requirements on a backorder criterion (i.e., expected number of unfilled requisitions at base supply). The new D041 will use an aircraft availability criterion, which the Air Force PPB process already uses to measure peacetime materiel readiness and wartime sustainability. (The availability of an aircraft type is the percentage of that type possessing a full complement of serviceable components.) Similarly, the Navy has a major "resystemization" effort under way that is intended eventually to replace LEVELS/STRAT (although current Navy plans afford aircraft availability no role).

gross requirement include operating requirements (components that fail and must be replaced), pipeline requirements (components in transit or repair), safety levels (to cover random fluctuations in pipeline contents), war reserve materiel requirements (to cover activities specified in wartime planning scenarios), and additives (anything not in another category). Assets include serviceable components on hand, components repairable at base level, components repairable at depot level, etc. (Most of the operating requirement--i.e., components that fail--can be repaired at base or depot level and returned to service.) D041 reports these computations in a standard product called the "item computation worksheet."

The ORACLE database contains the item computation worksheet entries aggregated across components. Entries are weighted by the purchase price of the component, so the results express the total dollar value of components. (For aggregating the depot repair requirement, we also use the depot repair cost as a weight.) Entries may be aggregated over any group of components, e.g., all F-xx components, or all navigational instruments. These aggregated figures may indicate potential problems soon to face the logistics system--for example, that a high and growing value of F-xx components will be tied up in transit between the flight line and the depot.

In D041, the average number of a component tied up in transit from base to depot is proportional to its level of flying activity. Similarly, the number that fail and must be replaced in an interval of time (the operating requirement) is proportional to the hours flown in that interval. ORACLE aggregates these and other proportionality factors in the same way as the worksheet entries. The aggregated factors indicate which activities by which weapon systems give rise to large requirements. Moreover, the factors can be combined to determine average transit and repair times for groups of components, average condemnation percentages, average depot repair percentages, etc. These quantities may show, for example, the degree to which a high value of components in transit from base to depot is due to: (a) a high percentage of components being repaired at the depot rather than the base; (b) a long transportation time; (c) a high rate of failures per flying hour; or (d) a lot of flying activity.

Finally, for each component, ORACLE calculates the derivative of its required purchases and repairs with respect to any programmed quantities that are inputs to D041 or LEVELS/STRAT.[2] Then ORACLE aggregates these derivatives in the same way as the worksheet entries. In the Air Force, program inputs include peacetime flying hours, programmed depot maintenance of aircraft, engine overhauls, peacetime aircraft availabilities (see footnote #1), and such wartime parameters as sortie rates and attrition rates. (Because of differences between LEVELS/STRAT and D041, the Navy list of program inputs is not as rich.) To rapidly assess the resource implications of changing the programs (as the PPB process must), one multiplies the program change by the appropriate aggregated derivative. If there is more than one program change, one computes the resource implications of each and adds them together. Or one may back-calculate to determine what reduction in, say, 1987 programmed F-16 peacetime flying hours will yield a needed savings in the 1985 budget, or what reduction in the planned 1987 F-16 wartime sortie rate will offset the 1985 budgetary impact of an increase in 1987 F-16 peacetime flying hours.

The aggregated derivatives provide only an approximate means to estimate the effects of program changes. To test the accuracy of the approximation, we built a test version of D041 and a prototype ORACLE to mimic it. For very large program changes (e.g., changes as large as 50 percent in peacetime flying hours), estimates made using the aggregated derivatives agree extremely well with the results of submitting the alternative programs to the test version of D041.[3]

---

[2]The derivative is the rate of change in dollars required for purchases or repairs as programmed quantities are varied by small amounts.

[3]AFLC currently calculates average costs per flying hour for buying and repairing components, and the PPB process uses them to adjust the requirements when the programmed flying hours are changed. But our validation exercise demonstrated that using the aggregate derivatives mimics D041 more closely. Moreover, there are derivatives relating requirements to many program quantities in addition to flying hours.

There are many potential users of the ORACLE methodology, although different users would need their ORACLE databases aggregated differently. In the Air Force, AFLC might aggregate across components requiring similar repair techniques, to help allocate repair workloads among the Air Logistics Centers (ALCs). Or, AFLC might aggregate across items managed or repaired at a given ALC to help allocate repair and buy dollars to the ALCs. Individual ALCs might aggregate over components repaired in the same shop or requiring the same skill for repair, to estimate future needs for shop capacities or particular manpower skills. The weapon system manager, another potential ORACLE user, might wish to aggregate items only to the subsystem level, rather than all the way to the level of his weapon system.[4] In the Navy, potential users include the Naval Air Logistics Center, which manages the Navy depots and ASO, which is responsible for buying and managing aircraft components.

S.3. SOME REMAINING ISSUES

The ORACLE methodology fails to address some problems in the planning and justification of component requirements. Two of the most important are forecasting and the tracking and control of execution.

Forecasting is a problem because of the two (or more) year delay between the start of the PPB process and the eventual results of execution. In that time, demand rates, depot repair percentages, condemnation percentages, etc., will change for many components. Modification programs will design new components to enter the inventory. D041 and LEVELS/STRAT optimistically assume that all of these changes can be anticipated perfectly, and hence they tend to underestimate future requirements. The ORACLE database inherits this flaw, since it mimics D041 or LEVELS/STRAT.

---

[4]As of this writing, AFLC is in the process of implementing ORACLE in their production version of D041. This will require more than to simply translate the equations of this report into computer code to add to existing D041 software. There are some differences in detail between the version of D041 we built to test ORACLE and AFLC's production version. Moreover, the production version is simultaneously undergoing a major modification.

This problem raises the issue of how far into the future the D041 or LEVELS/STRAT (and hence ORACLE) projections can be used.[5] To determine this, one might examine historical D041 databases. How much do demand rates of different types of components fluctuate over time? How long is a component likely to remain active in the inventory? Under what conditions will it be retired in favor of a newly designed component? And what do these factors imply for future dollar requirements?

Until the forecasting issue has been adequately studied, it is wise to restrict use of ORACLE to that period for which we are confident that D041 or LEVELS/STRAT forecasts of dollar requirements are reasonably accurate. It is the author's feeling that this period is no longer than five years--enough to allow ORACLE's use for the budget year. Others have questioned whether even this is optimistic.

No matter how well we can learn to forecast requirements, however, there will remain some uncertainty. In some years, enough requirements will emerge to outstrip funding, and the shortage in funding will eventually result in shortages in some components. Even when total funding is ample, the difficulty in forecasting demands for individual components guarantees that some components will be underbought.

To cope with the inevitable shortages, item managers can redistribute stock among flight lines or from wholesale to other echelons. Or they can affect key factors that influence component availability, such as transportation or repair times, by assigning high priority to the components that are short. However, close attention can be given to only a limited number of components, so it is important to single out the components that are in critically short supply.

---

[5] To use ORACLE for the full five years of the program, a forecast must be made of requirements for components to be on hand as much as 10 years in the future. Neither D041 nor LEVELS/STRAT project this far--D041 projects only six years at most--although the special version of D041 we built to test ORACLE forecasts requirements for 10 years. To use ORACLE for only the budget year requires a five year projection. This consists of a lead time of up to three years for procuring components, plus a two year delay from the time the projection is made until the budget is authorized by Congress and procurement actions can be initiated.

To aid in this task, the Air Force is developing the "Combat Analysis Capability system. Under that system, weapon system managers will be given access to Dyna-METRIC [5], and the databases needed by Dyna-METRIC will be assembled and kept current. Dyna-METRIC relates aircraft availability in peacetime and wartime to component repair times, demand rates, etc. It identifies which components are likely to keep aircraft unavailable in peacetime or wartime, and provides diagnostics to suggest how to work around the shortages.

We think that in its present form, ORACLE should have significant value for resource planning. In conjunction with an improved forecasting capability and an execution tracking and control system, ORACLE's value can only be enhanced.

ACKNOWLEDGMENTS

I am grateful to many people for helping to make these volumes possible.

- I. K. Cohen, who initiated the project.
- R. J. Hillestad, who led the project during the first of its two years.
- R. Cavender and J. Mandelbaum of OSD, who served consecutively as project monitors and provided valuable guidance.
- G. Halverson, Z. Lansdowne, B. Leverich, and R. L. Petruschell, who worked at various times on the project.
- G. B. Crawford, G. H. Fisher, and R. Shishko, who reviewed drafts and made many helpful suggestions.
- M. M. Aguilar and L. L. Harvey, for painstakingly typing the numerous manuscript corrections and revisions.
- P. G. Bedrosian, who edited the volumes and guided them to press.

CONTENTS

FIGURES

TABLES

GLOSSARY

AFLC	Air Force Logistics Command.
ALC	Air Logistics Center (an Air Force depot).
ASO	Aviation Supply Office (Navy).
AVCAL	Aviation Consolidated Allowance List (Navy).
AWARES	Assessment of Wholesale And REtail Support model.
AWP	AWaiting Parts.
BCM	Beyond Capability of Maintenance (Navy). See NRTS.
BES	Budget Estimate Submission (Air Force).
BLSS	Base Level Spares Support (Air Force). See D029, WRSK.
CAC	Combat Analysis Capability (a future Air Force data and computation system). (See Dyna-METRIC.)
CONUS	Continental United States.
CSIS	Central Secondary Item Stratification (Air Force).
DLM	Depot Level Maintenance (Air Force).
DoD	Department of Defense.
DG	Defense Guidance.
D029	WRSK/BLSS Authorization Computation System (Air Force). See WRSK, BLSS.
D041	Recoverable Consumption Item Requirements Computation System (Air Force).
DPEM	Depot Purchased Equipment Maintenance.
Dyna-METRIC	A model used to assess the effect of spare parts and their repair on sortie generation and aircraft availability in dynamic (e.g., wartime) scenarios. This model is at the heart of the CAC system.
EOH	Programmed Engine Overhauls at the depot (Air Force).
F&FP	Force and Financial Plan.

FMC	Fully Mission Capable (Air Force). Also see FMCS, NMCS.
FMCS	Fully Mission Capable for Supply (Air Force). Also see FMC, NMCS.
FMS	Foreign Military Sales.
FSC	Federal Supply Class.
ILM	Intermediate Level Maintenance.
LEVELS	Computer program used by ASO to compute buy requirements for individual components. There are similar programs to estimate repair requirements for individual components (Navy). See STRAT.
LCMS	Logistics Capability Measurement System (a computation system in use by the Air Force during the PPB process).
LMI	Logistics Management Institute (works for Air Force).
LOC	Line of Communication.
LOGRAMS	Model currently used in the Air Force to compute Other War Reserve Requirements (OWRM).
LRU	Line Replaceable Unit (Air Force). See SRU, SRA, WRA.
MAJCOM	Major Command.
MIL	Manpower, Installations and Logistics.
MISTR	Management of Items Subject To Repair (Air Force).
NALC	Naval Air Logistics Center (the management headquarters for the Navy depots).
NARF	Naval Air Rework Facility (a Navy depot).
NMCS	Not Mission Capable due to Supply (Air Force). See FMC, FMCS.
NRTS	Not Repairable This Station (Air Force). See BCM.
NSO	Numerical Stockage Objective.
OIM	Organizational and Intermediate Maintenance.
ORACLE	Oversight of Resources And Capability for Logistics Effectiveness.
OSD	Office of the Secretary of Defense.

OSI	Operational Support Inventory (Navy).
OWRM	Other War Reserve Materiel (see LOGRAMS, WRM, PWRM).
PA	Program of Aerospace vehicles and flying hours (Air Force).
PDM	Programmed Depot Maintenance of aircraft (Air Force). See SDLM.
PDM	Program Decision Memorandum.
P-DOCS	Program Documents
PDP	Program Decision Package.
PLSC	Pacific Logistics Support Center (Air Force).
POL	Petroleum, Oil, and Lubricants.
POM	Program Objective Memorandum.
POS	Peacetime Operating Stock (Air Force).
PPB	Planning, Programming, and Budgeting.
PPBS	Planning, Programming, and Budgeting System.
PWRM	Prepositioned War Reserve Materiel (see WRM, OWRM).
QPA	Average Quantity per Application.
RDB	Requirements Data Bank (Air Force).
RFI	Ready for Issue (Navy).
RR	Remove and Replace (Air Force).
RRR	Remove, Repair, and Replace (Air Force).
SDLM	Standard Depot Level Maintenance of aircraft (Navy). (Comparable to PDM in the Air Force).
SM	System Manager (Air Force).
SRA	Shop Replaceable Assembly (Navy). See LRU, SRU, WRA.
SRU	Shop Replaceable Unit (Air Force). See LRU, SRA, WRA.

STRAT	Computer program used by ASO to estimate total dollar requirements to buy components. There is a similar program to estimate total dollar requirements to repair components (Navy). See LEVELS.
USAF	United States Air Force.
VSL	Variable Safety Level.
WARS	Wartime Assessment and Requirements System (Air Force).
WMP	War and Mobilization Plan (Air Force).
WRA	Weapon Replaceable Assembly (Navy). See LRU, SRA, SRU.
WRM	War Reserve Materiel (see LOGRAMS, PWRM, OWRM).
WRSK	War Reserves Spares Kit (Air Force). See BLSS, D029.

1. INTRODUCTION

This volume reports on the development of a prototype methodology for assessing the effects of varying certain logistics resource levels on the peacetime materiel readiness and wartime sustainability of the U.S. air forces. The methodology, called ORACLE (Oversight of Resources And Capability for Logistics Effectiveness), is intended primarily for use in the annual Planning, Programming, and Budgeting System (PPBS) exercises, so that support resources can be better planned and justified. But we feel that it can also be useful during execution--i.e., in budget allocation decisions, and in management decisions involving the actual obligation and expenditure of funds for logistics resources.

We have built a prototype of the ORACLE methodology that deals only with the purchase and repair of recoverable aircraft components--parts that can fail and be repaired and reused. (Consumable parts, in contrast, are discarded once they fail.) However, the methodology we describe can be adapted fairly easily to individual repair resources, such as manpower, repair parts, test equipment, or facilities space. It can also be adapted to estimate transportation requirements.

Ultimately, we wish to judge improvement in logistics management by its effect on combat capability, e.g., "bombs on target." The present state of the art, however, limits us to estimating its effect on aircraft availability given a peacetime or wartime flying program. (We define the availability of a given aircraft type as the percentage of that type possessing a full complement of serviceable components. The actual number of aircraft available to fly sorties will generally be different than the aircraft availability measure indicates. An aircraft may have a full complement of serviceable components but be in maintenance. Or an aircraft may have an unserviceable component, but nonetheless be able to fly sorties of a kind for which that component is not essential. Thus, it is more descriptive to say that an aircraft is "Fully Mission Capable for Supply (FMCS)" than to say that it is "available." We will use the two forms interchangeably.) We identify

the peacetime flying program and peacetime aircraft availability with the notion of "peacetime readiness," and the planned wartime flying program and wartime aircraft availability with "wartime sustainability."

We intend our methodology to be useful to both the U.S. Air Force and U.S. Naval Air Forces. However we developed this methodology largely using Air Force data, to which we had better access. Thus, the methodology described here is more suited in detail to an Air Force context and will require some adaptation before it can be used by the Navy. Moreover, the discussion of current practices, while true in general for both the Air Force and Navy, is true in detail only for the Air Force.

The report is organized as follows. In Sec. 2 we discuss how aircraft components are currently managed during execution and what changes are to be anticipated in the near future. In Sec. 3 we turn to the PPB system and examine how components are dealt with there.

With these sections as background, we define in Sec. 4 the characteristics of a methodology that will provide consistency in component management between execution and the PPB system. Then we develop the methodology itself. Section 4 is the longest and most detailed section, and all but Secs. 4.1 and 4.2 might well be omitted at a first reading. Even at that, we have relegated the most technical of the details to two appendixes.

Section 5 describes the prototype we have built to test the ORACLE methodology.

Finally, Sec. 6 suggests some directions for further research, which might enable us to significantly increase the usefulness of the methodology.

2. COMPONENT MANAGEMENT DURING THE EXECUTION STAGES

The world of recoverable components may be represented as two interacting hierarchical structures. One, the indenture structure, relates components to aircraft. The other, the component support structure, describes the flow of components through the logistics system, which is composed of maintenance and supply functions, and the transportation system, which moves components from place to place.

2.1. THE WORLD OF RECOVERABLE COMPONENTS

Aircraft are composed of components, which in turn may be composed of subcomponents. Examples of components are guns, gunnery and bombing fire control systems, structural components such as bulkheads and canopies, control surfaces such as stabilators, landing gear struts, wheels and brakes, jet engine components such as fuel control assemblies and fan blades, pumps, valves, radars, and navigational instruments. An aircraft is typically composed of thousands of components and subcomponents.

If all components and subcomponents are operating satisfactorily, we say the aircraft is FMCS. (It might not actually be mission capable if it needs maintenance, for example. But in this report we only consider the effects of component supplies on aircraft status.) Failed components are discovered, removed, and replaced (if replacement stock is available) at the flight line, and the failed component is sent to a shop at an Intermediate Level Maintenance (ILM) facility for repair. The removal and replacement of components at the flight line is called organizational maintenance. Together, organizational and intermediate maintenance are abbreviated as OIM. If no replacement is available for a component removed from an aircraft, a "hole" is created, and until a replacement can be obtained from another location, or--if permitted--by cannibalizing another aircraft that is missing a different component, the aircraft will be Not Mission Capable due to Supply (NMCS) and will be unable to fly any mission for which the missing component is essential.

At the ILM, the failed component enters the repair process. During repair, it may be found that one or more of its subcomponents are defective. They will be removed, and the resulting "holes" in the parent component will be filled by replacement subcomponents, if available, or by cannibalizing other components at the ILM, if they are available and cannibalization is allowed. If subcomponents cannot be obtained from either of these sources, the parent component must remain in Awaiting Parts (AWP) status until subcomponents can be obtained from another location.[1]

Meanwhile, the defective subcomponents may themselves enter the repair process at the ILM, and failed sub-subcomponents may be discovered. There is no theoretical limit to the number of levels of indenture that can be considered, but at the ILM it is not common to encounter more than two levels.

It is important to distinguish between the indenture structure as described by engineering drawings of an aircraft and that implied by maintenance practices. For example, the engineering drawings of the C-5A nose landing gear show that a component called an arm assembly is a subcomponent of the nose strut. But the organizational maintenance crew will often remove the arm assembly directly from the aircraft; they will rarely remove the entire strut and send it to the ILM to have the arm assembly taken off. This distinction between two kinds of indenture is recognized in the terminologies used in both the Air Force and the Navy; in the Air Force there are Line Replaceable Units, or LRUs, that are removed and replaced at the flight line, and Shop Replaceable Units, or SRUs, that may be detached from their parent components at the ILM but not at the flight line. In the Navy, the corresponding terms are Weapon Replaceable Assemblies (WRAs), and Shop Replaceable Assemblies (SRAs).

---

[1]Note the similarity between an aircraft and its components at the flight line, and a component and its subcomponents at the ILM. In both cases there is a need for replacement stock; cannibalization is a potential source of supply. The penalty for having too little supply is an inoperable hulk--an NMCS aircraft in the one case, and an AWP component in the other.

For our purposes, the indenture structure defined by maintenance practices is the one of interest.

The most usual topology for the component support structure is shown in Fig. 1. It has three echelons, which are connected by transportation links. The first echelon is organizational maintenance at the flight line (Fig. 1, left). The flight line is supported by a usually collocated ILM and supply point, which is the second echelon (Fig. 1, center). Any support that the ILM cannot provide--e.g., if a component is beyond repair by the means available at an ILM--must be provided by the wholesale part of the system, the third echelon (Fig. 1, right). The wholesale echelon, like the echelon before it, consists of a supply function (wholesale supply) and a repair function (depot-level repair). And as at the ILM, the indenture structure affects activity at the wholesale echelon; a component in repair at the depot may yield failed subcomponents. The depot generally carries repair to deeper levels of indenture than the ILM.

Echelon one is connected to echelon two, and echelon two to echelon three, by transportation links in both directions. The times required for components to traverse these links are understood to include administrative delays as well as the time used actually moving items from place to place. (Indeed, the administrative delays typically account for the lion's share of the total "transportation" time.) The links from echelon one to two, and from two to three, carry failed or repairable components; the links in the other direction carry serviceable components.

Other topologies are possible, even encountered. In the Air Force, Pacific Command, the individual bases have surrendered most of their ILM capability to the Pacific Logistics Support Center (PLSC). Because some capability remains at each flight line, this has the effect of adding a fourth echelon to the system. And one can readily imagine still other arrangements.

To work smoothly, this system must have sufficient stocks to fill the transportation and repair "pipelines" and to provide contingency stocks--a "safety level"--against periods of unexpectedly high demands. The system must also own war reserve stockpiles at the flight line and retail echelon (Prepositioned War Reserve Materiel, PWRM) and at the

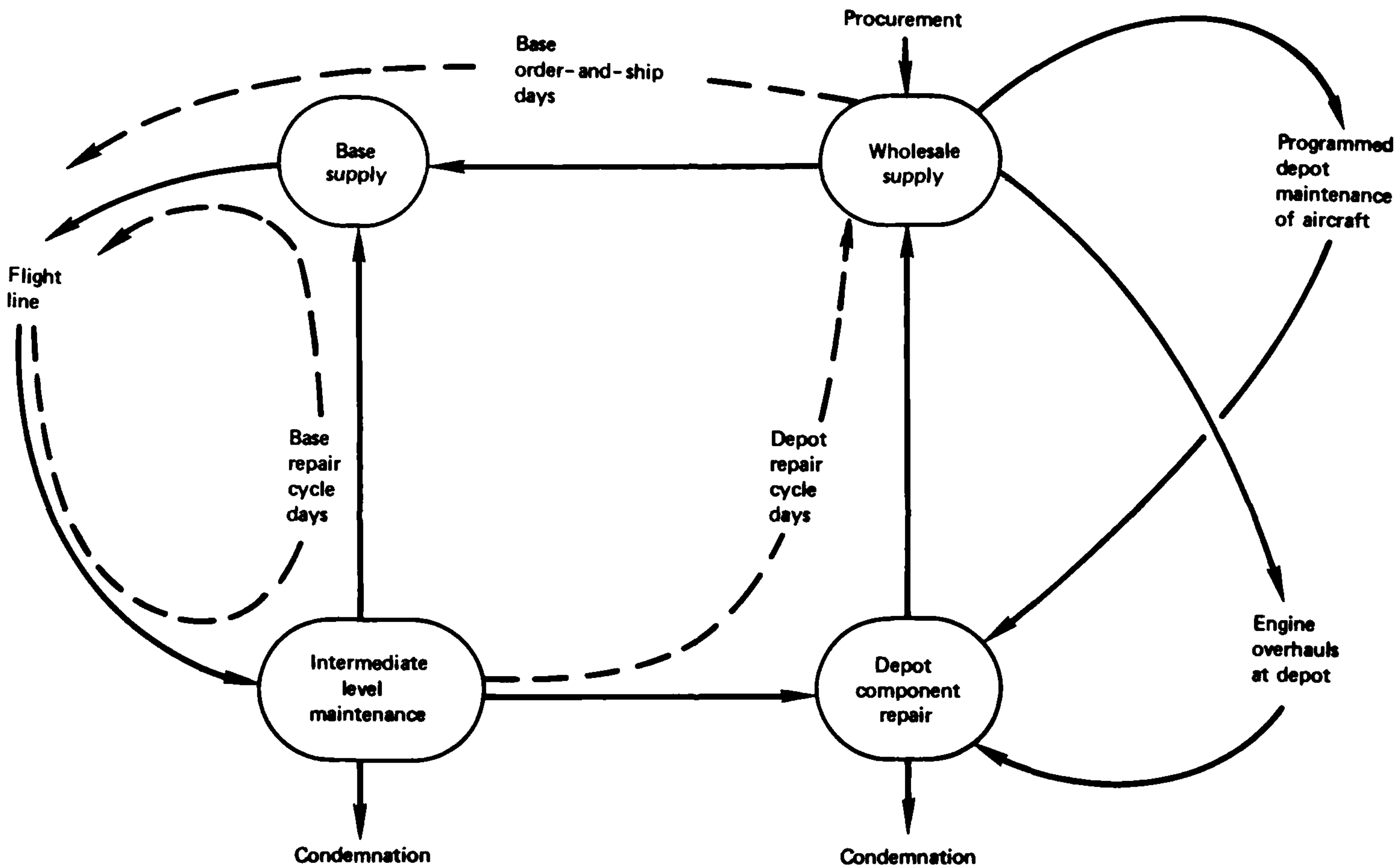


Fig. 1 — The component support system as modeled in D041

wholesale echelon (Other War Reserve Materiel, OWRM) from which demands can be satisfied while the wartime pipelines are filling. Losses of components through condemnation and increases in pipeline requirements stemming from changes in flying activity will periodically necessitate the purchase of new components. The system must also be able to transport and repair components as needed to meet demands at the flight line.

2.2. MANAGEMENT SYSTEMS FOR RECOVERABLE AIRCRAFT COMPONENTS

Now consider the day-to-day management of the component support system. In the Air Force there are "item managers," who are responsible for the day-to-day management of individual components, and "system managers," who are responsible (in some ways) for day-to-day management of weapon systems. We intend to include both functions when we use the term "manager." The Navy has "inventory managers," who are much the same as the Air Force's item managers; but they do not have the counterpart of the system manager. Both services rely on huge computerized management information systems to help them manage their recoverable components.

2.2.1. The Air Force's D041 System

In the Air Force, the item manager relies on a system known as D041: Recoverable Consumption Item Requirements Computation System [1]. (The Air Force uses the terms "item" and "component" almost interchangeably. A component may always be called an item. But some items are "end items"--e.g., aircraft or engines--which have components installed on them but are not themselves components.) The purpose of the D041 system is to estimate, for each of the roughly 150,000 different components owned by the Air Force, the number that should be repaired at the depot, the number that should be bought, and the number that should be disposed of at various times in the future. Each quarter, D041 projects required purchases and depot-level repairs of each item between 2-1/2 and 3-1/4 years into the future, the length depending on the quarter. The requirements for each component are based on programmed future activity rates, and factors such as demands per unit of activity and repair times. Factor values may be standards,

historically observed values, or forecasts. Future activities and programmed capabilities that may generate demands for components include peacetime flying hours and wartime planning scenarios (established by Hq USAF), as well as Programmed Depot Maintenance (PDM) of aircraft and engine overhaul programs (maintained by the Air Logistics Centers (ALCs)).

In broad outline, the computation method is the following. First, the gross requirement for serviceable components is calculated at all times of interest. The gross requirement for a particular component consists of five different kinds of quantities--operating requirements, pipeline requirements, safety levels, war reserve requirements, and additive requirements. Operating requirements consist of components that fail during an interval of time and must be replaced. Operating requirements accumulate over time as more and more components fail; but most failed components can be repaired and returned to service. Thus, operating requirements measure the rate at which the components will circulate through the system.

Pipeline requirements consist of the number of components expected to be in the various transportation and repair pipelines during peacetime. Safety levels are provided because the pipeline contents vary randomly and sometimes exceed the expected number. If there were no safety stock, and the pipelines temporarily contained more components than expected, the incremental stock would have to be taken from war reserves, or from aircraft. Safety stock cannot prevent this altogether but can reduce its frequency of occurrence.

In the event of war, demands for many components are expected to increase beyond peacetime levels, and wartime pipelines will be larger than their peacetime counterparts. War reserve stocks provide the incremental stock needed to fill the wartime pipelines and to satisfy demands during the interval when the pipelines are filling. Some war reserves must be positioned at the flight line (PWRM), to satisfy demands that will arise in the first few days of war, before the wholesale echelon can deliver the needed stock. Additional stock (OWRM) may not be needed early in the war but may be required to sustain operations in the longer term, until manufacturers can begin producing components as fast as wartime operations consume them. Neither the PWRM

nor OWRM requirements are calculated by the D041 system. A program called D029 computes the PWRM requirement, and the LOGRAMS program calculates the OWRM requirement. Both are then passed to D041 for inclusion with the rest of the requirements.

Finally, additive requirements consist of all requirements not identified as belonging in one of the previous categories. They include requirements to support foreign military sales (FMS), special training programs, interservice agreements, etc.

The total gross requirement is calculated for each quarter of the D041 projection. From the gross requirement calculated for each quarter is subtracted serviceable assets on hand. (In the event that on-hand assets can by themselves cover requirements for a considerable period in the future, some of the components may be declared excess and disposed of.) If there remains an unsatisfied requirement at any time covered by the computation, the repairable components generated at the ILM facility by that time are assumed to be repaired (with an allowance for condemnations), up to the number of repairables available, or up to the remaining requirement, whichever is smaller. Next, repairable components generated at the depot are repaired, again with an allowance for condemnations, up to the smaller of the number of repairables available or the remaining requirement. Should any requirement remain after this step, it may be satisfied by receipt of components presently on order, these being subtracted from requirements only at times later than the expected date of receipt. Should there still be any unsatisfied requirement, it must be filled by the purchase of new components. The buy order of course must have been placed at least a procurement lead time before the time the items are required. By this means, both the buy and depot-level repair requirements can be estimated for various times in the future.

D041 is run twice during each quarterly exercise. The first time, the results are passed out to the item managers for review. They have about one month to locate errors and to revise the forecast values of the various factors on which the requirements depend, such as demands per flying hour and condemnation rates. Each suggested change is scrutinized by several people, and if it passes scrutiny, it is entered into the D041 database. D041 is then run a second time, using the

updated database; these are the D041 results that are used to manage components.

Both the buy and repair requirements are produced in two forms: They are presented to each item manager for the items he manages; and they are produced in an aggregate form called the Central Secondary Item Stratification (CSIS), which by DoD instruction [2] is a required input into the PPBS.

2.2.2. The Navy's LEVELS and STRAT

The Navy uses a system similar in many ways to D041 to help manage approximately 64,000 components. Each aircraft carrier, when it deploys, calculates an Aviation Consolidated Allowance List (AVCAL), consisting of the components it must have on board to support the peacetime and planned wartime flying of its aircraft during a 90-day cruise. The carrier inventories the components it has on hand and requisitions the remainder from the wholesale echelon. Similarly, the Naval Air Stations, where all Navy shore-based aircraft are assigned, incorporate their Operational Support Inventory (OSI) requirements for components to support planned peacetime flying (planned wartime flying by shore-based aircraft is mostly for training and has much the same intensity as peacetime shore-based flying.) They, too, inventory their stock on hand and requisition what they need from the wholesale echelon. The Aviation Supply Office (ASO) is the part of the wholesale echelon responsible for filling these requisitions, and it participates in the calculations (they are as much a negotiation as a calculation). Carriers generally submit most of their requisitions shortly before they deploy. Naval Air Stations submit new requisitions continually, each time their inventory changes (e.g., each time a component fails and cannot be repaired at intermediate level).

Twice each year, ASO summarizes the requisitions and adds them to the numbers of components required to fill pipelines in the wholesale echelon and to serve as OWRM. Assets available at the wholesale echelon--which do not include assets "owned" by carriers or Naval Air Stations--are applied to obtain the buy requirement, in a process much the same as the one used in D041. In the Navy, the LEVELS [3] program computes the buy requirement for individual components, and STRAT [4]

accumulates these requirements across components to obtain dollar totals for input into the PPBS. The repair requirement is estimated by separate programs, but the procedure is much the same as that used in D041.

Obviously, there are differences between the Air Force and Navy systems, but they nonetheless have much in common. Both compute gross requirements based on expected peacetime and wartime activity rates. Both apply assets on hand against the gross requirement to determine net buy requirements for each component. Both carry out these calculations for each of a large number of components. These common aspects ensure that the ORACLE methodology can be applied equally well in both services.

2.3. SHORTCOMINGS OF D041 AND LEVELS/STRAT

When considered solely as systems for assisting day-to-day management of components, D041 and LEVELS have a number of shortcomings. (Both Air Force and Navy systems have additional shortcomings when one considers their roles as providers of information to the PPB process. But we defer discussion of this aspect until Sec. 3.) One lies in the fragmented nature of the computation. PWRM requirements are computed in the D029 system, which is separate from D041. OWRM requirements are computed in a model called LOGRAMS. D041 calculates pipeline requirements and safety levels and combines them with the quantities obtained elsewhere. In the Navy, the AVCAL, OSI, and wholesale requirements are calculated separately. It is clear that when requirements are calculated by such a widely distributed process, one runs a grave risk that something will fall between the cracks. Consistency in assumptions from one part of the computation to another is hard to maintain.

A second shortcoming of D041 and LEVELS is their cumbersome natures. The systems, and any replacement systems, will need access to so much data, and these data will require so much effort for collection and verification, that the system can never be very responsive. The process of updating the database and computing new requirements estimates will always take weeks or months. But a real-time capability could be added to simulate individual items, and historical data could

be retained to make possible statistical and other analyses of individual items.

A third shortcoming, one more susceptible to correction, is the inability of the present systems to target buy and repair recommendations at individual weapon systems. The recommendations are made item by item, and early in the computation the link between item and weapon system is lost. Moreover, each recommendation is based on a backorder criterion in the Air Force (i.e., expected number of unfilled requisitions at base supply) and a fill rate criterion in the Navy (i.e., likelihood that a requisition at wholesale can be filled immediately upon receipt), and if followed may enable the support system to achieve low backorders and exemplary fill rates but mediocre aircraft performance.

A final shortcoming is that D041 and LEVELS make many assumptions about the repair times, transportation times, demand rates, etc., of each component. These parameters and others are subject to change, sometimes because of (and other times in spite of) management actions. Following the recommendations of a D041 or a LEVELS does not ensure that management objectives will be achieved. It is also necessary to track these parameters, to determine which deviate in objective-threatening ways from the assumed values, and to find ways to achieve the objectives in spite of these deviations. In the remainder of this section, we will discuss present Air Force and Navy plans to address each of these shortcomings.

2.3.1. Toward Less Cumbersome and Fragmented Systems

The fragmented and cumbersome natures of D041 and LEVELS can be corrected only in the long term; no "quick fix" is possible. The Air Force is currently developing a remedy--WARS/RDB, the Wartime Assessment and Requirements System, and the Requirements Data Bank. AFLC presently plans to use WARS only to calculate war reserve requirements and to continue to use D041 to compute the peacetime requirements. But WARS treats all scenarios in the same way, whether peacetime or wartime, so there is no need to maintain two parallel systems. WARS can run a wartime scenario to estimate a total requirement for wartime and then can run a peacetime scenario to compute the peacetime portion of the

requirement. WRM can be taken as the difference. WARS also distinguishes between locations--flight line, ILM, wholesale--and positions the stock where it is needed, so there is no need to compute PWRM separately from OWRM, as the present system does.

WARS is also designed to compute requirements to meet aircraft availability objectives stated for different times in the planning scenario. These objectives will be stated separately for each weapon system, so the buy and repair recommendations of WARS can be targeted at specific weapon systems. Thus, the replacement of D041 by WARS will address two of the three shortcomings we have identified.

If, in addition, the Air Force Logistics Command (AFLC) can obtain new data processing equipment and configure the WARS software to take advantage of its capabilities, then WARS can be made less cumbersome than the present system.

The Navy is engaged in a major "resystemization" effort, which will replace both the computer hardware and software of LEVELS and STRAT with more modern versions. We expect that the modernized systems will be considerably less cumbersome than the present ones, since much has been learned about organizing and processing large data files in the last two decades, and since computer architecture and operating systems have become more sophisticated. But we understand that the new software replaces only LEVELS and STRAT and does nothing to unify the calculations of AVCAL and OSI with the wholesale calculation.

2.3.2. Targeting Requirements at Weapon System Performance

AFLC is attempting to modify D041's safety-level computation to recommend buys and repairs of components in such a way as to achieve aircraft availability targets for individual weapon systems. This criterion is only to be applied to peacetime operations, but it nevertheless represents a step forward. D041 computes requirements for specific components. This makes it useful for managing individual components (which is a task that must be performed), but the Air Force mission is not directly concerned with components; components are important only to the degree that they support weapon systems. D041 will thus be improved when it bases its buy and repair recommendations on how well weapon systems are being supported. (WARS bases both

peacetime and wartime requirements on the aircraft availability criterion, so this advance will not be lost when WARS replaces D041.)

ASO has no plans at present to incorporate an aircraft availability criterion in LEVELS/STRAT. Indeed, since LEVELS/STRAT are concerned only with the wholesale echelon, and not with the retail echelon where all flying activity occurs, incorporating aircraft availability in LEVELS/STRAT alone would have limited utility. If ASO should decide in the future to incorporate aircraft availability criteria in their component management system, they should consider changing the AVCAL and OSI computations as well as LEVELS/STRAT.

2.3.3. Tracking and Managing Actual Performance

Finally, both D041 and LEVELS/STRAT make numerous assumptions about the process by which components are actually used and managed. (This is true of all models and is not intended as a criticism peculiar to D041 or LEVELS/STRAT. It will remain true of D041 when the aircraft availability objective is incorporated, and it will be true of WARS when WARS finally replaces D041. And it is true of the Navy systems.) For example, D041 assumes that repair times, transportation times, failure rates, etc., are known constants. But these factors change over time, partly because of human intervention and partly at random. Thus, when the items ordered today are finally delivered, perhaps two years later, they may not enable the logistics system to provide the same support as the original requirements computation anticipated they would. Some items will (in retrospect) have been overbought and others underbought. If day-to-day management cannot compensate for the shortages of the latter group of components, operational performance will suffer.

Fortunately, the manager has certain policy levers at his command that can help reduce this effect. For example, the manager can redistribute stock among flight lines, or from wholesale to other echelons. By providing for dynamic, real-time redistribution, the manager can reduce the need for safety stock; the portion of safety stock that becomes excess can now be used to fill pipelines. Redistributions beyond the safety levels cut into WRM stocks and reduce wartime capability in favor of peacetime activity.

Or the manager can affect key factors that influence component availability, such as transportation or repair times, by assigning high priority to the components that are in short supply. Their processing through supply and maintenance organizations is expedited; they travel by air instead of ship, train, or truck. These measures reduce the time a component spends in the pipelines and hence reduces the number of components in the pipelines.

Nor is it only a single manager (e.g., the item manager) who can compensate for shortages of stock. Base maintenance personnel may work overtime to expedite the repair of critically short items. Pilots, knowing that an item cannot be replaced, may fly an aircraft with that item working poorly or not at all, thus reducing the item's apparent failure rate. However, the manager (and others) can devote close attention to only a limited number of components and can give priority to only a few. Thus, although these policies will work for any component, they cannot work for all components simultaneously.

To help determine which components require special attention if weapon system support targets are to be achieved, and to identify effective management actions for those components, the Air Force is developing the Combat Analyses Capability (CAC) system. The CAC system is based on Rand's Dyna-METRIC [5] model, and will make this model, together with the needed updated and verified databases, available to weapon system managers and (perhaps) item managers. The CAC system will provide feedback from the field on the actual effect of component management on weapon system status. Dyna-METRIC relates the stocks of components to aircraft availability in peacetime and wartime. As a tool for day-to-day management, it can provide the kinds of information needed to pursue the stated service goals of wartime operational capability. Instead of supply-oriented information related to the current, peacetime situation (how many widgets are currently backordered?), Dyna-METRIC provides measures of the wartime capability of the operating forces (how many aircraft will be available after a week of war?); and Dyna-METRIC also provides measures of how badly a component shortage hurts (if I lose two more widgets, how many more aircraft will be grounded?).

The Dyna-METRIC model is also available to the Navy, but no Navy counterpart of CAC is currently in development or planned. Nor does the Navy have a counterpart of the weapon system manager. But there are Naval officers who are responsible for the performance of a carrier deck load consisting of many different kinds of aircraft. Perhaps a CAC-like system could provide this office with useful management support.

3. COMPONENT MANAGEMENT IN THE PPB SYSTEM

To calculate requirements for recoverable components, D041 must be provided with programs of future activities, including peacetime flying hours, wartime planning scenarios, and certain maintenance and modification programs. Peacetime flying hours and wartime planning scenarios are obtained from Air Force documents. These programs are decided during the annual PPB exercises. Schedules for maintenance on aircraft and engines are developed by AFLC and not as a part of the PPB process, although the resources to support these programs must be approved during PPB. Similarly, resources for modifications must be approved during PPB. LEVELS/STRAT also require program inputs, which the Navy decides as part of their PPB process.

Figure 2 depicts the annual PPB exercises and their relation to execution, in the case of components. Planning sets general goals, including those of peacetime materiel readiness and wartime sustainability (recall that the purpose of ORACLE is to relate logistics resources to these goals). Programming further refines the goals, expressing them in terms of the activities and capabilities that appear in the program, and maps out how to reach those goals within (rough) resource limits. Budgeting puts together a detailed plan of expenditures for the first year of the program. The program devised in the PPB process is used to guide execution, which we take to include the actual expenditure of money to acquire resources and the day-to-day activities of the service. The next several subsections will describe in greater detail the three stages of the PPB process, which is where we intend that ORACLE should primarily be used.

3.1. PLANNING

The purpose of the planning stage is to set general goals for the services over time. Some of the goals are expressed in terms of operational capabilities, such as wartime scenarios that the services must be prepared to prosecute. Other goals, such as "peacetime materiel readiness" and "wartime sustainability" must be translated into

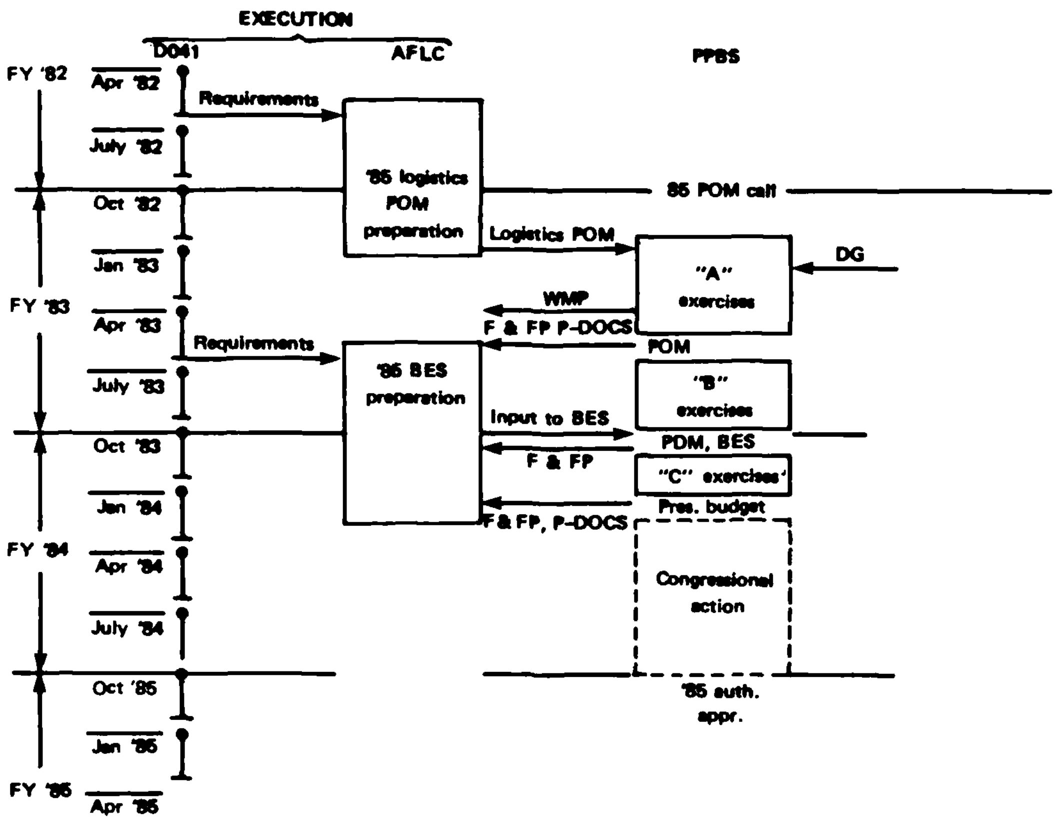


Fig. 2 — Component support in the Air Force PPBS

operational capabilities, by the Office of the Secretary of Defense (OSD) or by the services. Planning in DoD is based, in theory, on a continuous assessment of the military threats against the United States. OSD, the Joint Chiefs, and the individual services all conceive of scenarios that particularize those threats and that the services should therefore be prepared to prosecute. Planning is a continuous activity, but every year it spins off the Defense Guidance (DG), which guides all subsequent PPBS activity for that year. The DG is scheduled to appear in January.

3.2. PROGRAMMING

Programming translates the goals set in planning into a five- (or more) year schedule of peacetime activities and wartime planning scenarios (a program), and adjusts the program to prevent the time-phased resources needed to execute it from exceeding given limits. Programming occurs in two parts. First, using the DG and information from the major commands as inputs, each service constructs a Program Objective Memorandum (POM) that describes the proposed program--i.e., activities and capabilities to be achieved over a five-year period and the time-phased resources required to achieve them. Second, OSD reviews the service POMs, revising as necessary, and issues them in final form as Program Decision Memoranda (PDM). (Recall that PDM also refers to Programmed Depot Maintenance of aircraft. However, the context should make clear which meaning of PDM we intend.) The services prepare budget estimates (called in the Air Force the Budget Estimate Submission, or BES), which detail the resources needed to carry out the PDM. The POM is typically issued in May or June and the PDM and BES in September.

A very good description of what goes on during this stage, at least for the Air Force, can be found in Ref. 6. It is clear from this description that constructing the POM is a frantic activity, in which the initially proposed program is revised repeatedly. In the Air Force, all proposed activities are described in Program Decision Packages (PDPs), which are ranked in a "rank bank" in order from most important (bottom) to least important (top). Each PDP is intended to describe a bite-sized, self-contained candidate "chunk" of the Air Force program. By choosing to fund or not to fund individual PDPs, the Air Staff can adjust the resource requirements to match their estimate of available funding.

Program changes are made by shuffling the order of PDPs in the rank bank. First, the members of the various panels and committees of the Air Force board structure decide which PDPs should be "below the line"--i.e., funded. Once a consensus is reached, at least provisionally, the panel and committee members produce an "exercise guidance" document, which their staffs use in reestimating the costs of all the PDPs, and in updating the rank bank. After the rank bank is updated, the process can

begin again. Each cycle in this process--i.e., the time from one update of the rank bank to the next--consists of creating a new alternative five-year program for the Air Force, and then taking stock of the implications of the new program for resource needs.

3.3. BUDGETING

Budgeting strips the first year's program and resources from the PDM and the BES and converts them into the defense section of the President's Budget. Budgeting also transforms the BES so that the money in the plan is categorized in the terms required by Congress (appropriation categories). In the PDM, resource needs were related instead to major force programs and program elements. In the preparation of the financial plan for the Air Force, the comptrollers receive information once again from at least some of the major commands. The output of this stage is the President's Budget, which is submitted to Congress in January, a year after the start of programming.

The President's Budget is debated, and parts of it changed, by Congress, and is scheduled to be enacted by the start of the fiscal year in October, nearly two years after the start of programming. Once Congress passes it, OSD parcels it out to the individual services, which allocate it to major commands, which allot it among subordinate units. And finally, the money can be obligated and spent to achieve the program.

3.4. COMPONENT RELATED INPUTS TO THE PPB PROCESS

Figure 2 shows the PPBS receiving information on components from D041 via AFLC at two points in the cycle. In October, Hq USAF issues a call for inputs to programming (the POM call), to which the major commands, including AFLC, respond in early January. Nine months later, AFLC has an opportunity to provide inputs to the BES. In both cases, the AFLC input for components takes the form of the CSIS plus some auxiliary information.

At the left of Fig. 2, D041 is shown making quarterly estimates of the requirements to buy and repair components. Developing an estimate takes most of the quarter, so the estimate based on data from the last day of the previous quarter (the "asset cutoff date") is only available

near the end of the current quarter. AFLC scrubs this estimate before passing it to Hq USAF. To allow time for the scrub, AFLC uses the D041 computation with an asset cutoff date of March 31 as the basis for inputs to both the BES of one PPB cycle and the POM of the next.

We can identify three problems with the use of D041 to provide inputs to the PPBS. First, the PPB process--particularly the programming stage--considers many different programs in the course of reconciling planning goals with resource limits. Periodically there emerge from the PPBS new official versions of the program and the corresponding budget.[1] The resource implications of all these different programs must be rapidly assessed, but D041 cannot respond rapidly. Second, the March 31 computation forecasts requirements only 2-1/2 years beyond the asset cutoff date. If AFLC's input to the POM is to cover the five POM years, D041's projection of requirements must be extended 7-1/2 years beyond asset cutoff.

AFLC's solution to the first two problems is to calculate average costs per flying hour for repairs and purchase requirements. AFLC excludes one-time and WRM requirements from the D041 projection, and partitions the remaining requirements among weapon systems. The requirements thus associated with each weapon system are divided by that system's programmed flying hours. To project requirements beyond D041's horizon, these average cost factors are multiplied by the flying programs for future years. To adjust the requirements when the programmed flying hours are changed, the requirements projected for any given year are incremented (decremented) by the product of the average cost factors and the increase (decrease) in flying hours of the corresponding weapon system.

This approach can potentially cause major errors in estimates of required component purchases, because the cost factors represent average not marginal costs. (The marginal cost measures the change in cost that occurs when one more flying hour is added to the program in a given year.) At any point in time, there is available a large inventory of components, which by themselves can support a good deal of peacetime

---

[1]In the Air Force, official versions of the program are published in the War and Mobilization Plan (WMP) and the P-series documents, of which the one of interest for components is the PA. The budget is published in the Force and Financial Plan (F&FP) [7].

flying. These components have already been bought and paid for; their costs are "sunk" and are excluded from the cost calculated by D041. It is only for flying in excess of the amount supportable by components on hand that D041 will estimate that more components must be bought (and hence costs incurred). It is to these excess flying hours that the cost of additional component purchases should be attributed at the margin. This is in contrast to the average cost approach, which attributes the cost of additional components equally to all flying hours. It follows that the marginal cost per flying hour exceeds the average cost per flying hour. Indeed, the marginal cost per flying hour may be as much as ten times larger than the average cost per flying hour.

AFLC's average cost factors relate changes in requirements only to changes in peacetime flying hours. But the programmer also needs a way to adjust requirements for changes in other programmed activities, such as wartime planning scenarios, scheduled PDMs and modifications to aircraft, and engine overhauls.

The third problem concerns the use of aircraft availability during the PPB process but not in D041. During this PPB process, the Air Force uses aircraft availability to measure the effect of components on peacetime materiel readiness and wartime sustainability. (Recall that the availability of an aircraft type is defined as the percentage of that type possessing a full complement of serviceable components--being FMCS. Peacetime materiel readiness is measured in terms of the availability that can be achieved while executing the peacetime flying program determined in the PPB process. Wartime sustainability is measured in terms of the availability that can be achieved at various times in the wartime planning scenarios specified during PPB. But D041 currently makes no use of an aircraft availability measure to compute peacetime-related requirements and only limited use of availability in computing wartime-related requirements. (Requirements for PWRM are calculated using an availability objective, but not OWRM requirements.) In place of aircraft availability, D041 uses a backorder objective. Thus, the Air Force tries to plan and justify money for components in terms of aircraft availability objectives, but spends the money to achieve a backorder target instead.

The tools used by the Air Force to incorporate availability measures into the PPB process are two computer models, which together form the Logistics Capability Measurement System (LCMS): the Aircraft Availability Model [8], and the Overview Model [9]. These models are driven by the same databases that drive D041. They relate component purchases and repairs to aircraft availability, not fill rates. Moreover, they avoid the use of average cost factors. And LCMS considers wartime scenarios, thus potentially offering a way to relate changes in requirements to this part of the program. Although these models still carry out their computations item by item, they are much more responsive than D041. In part this is because they have been judiciously designed to carry out their computations efficiently and to save key intermediate results from the computation of requirements for one alternative program to use for other alternatives. But the D041 computation cycle involves a great deal of effort updating and verifying the input data, whereas these models simply accept the most recent D041 database as given.

But LCMS was introduced into the PPB process without compensating changes being made in D041. It enables the programmers to build the program and corresponding resource requirements to achieve aircraft availability targets, but it does nothing to enable execution to proceed accordingly. In response to this shortcoming, AFLC is adding the aircraft availability objective to D041, and this may make D041 and the LCMS models consistent for a time. But D041 has a long history of successive modifications, and more can be expected in the future (including its replacement or partial replacement by WARS, as described above). And the LCMS models will undoubtedly also be changed over time. Unless the models used in execution (currently D041) can be tied somehow to the models used in the PPB process (currently LCMS), they will inevitably diverge, and headquarters will thereby lose some measure of control over the operating commands.

4. ORACLE: A PROPOSED LINK BETWEEN EXECUTION AND THE PPB PROCESS

4.1. CHARACTERISTICS OF ORACLE

The previous sections suggest four characteristics that a methodology should have to be useful for estimating component buy and repair requirements in the PPB process. First, it should offer a means to rapidly investigate the consequences of changes in a wide variety of programmed activities and capabilities, such as (but not limited to) peacetime flying hours and planned wartime sorties. Second, the methodology should be consistent with D041 (in the Air Force) or LEVELS/STRAT (in the Navy). That is, it should give the same estimates for requirements as D041 or LEVELS/STRAT would give if provided with the same values for programmed quantities as input. Third, the methodology should be easy to update, so that it will remain consistent with D041 or LEVELS/STRAT as those systems and their data are changed. Finally, it should link component requirements to aircraft availability, which is used in the PPB process (at least in the Air Force) to measure peacetime materiel readiness and wartime sustainability.

We suggest that this methodology could take the form of an aggregate database abstracted from the execution system (D041 or LEVELS/STRAT), plus a spread-sheet-like program for manipulating the elements in the database and for displaying the results in convenient forms. If the database were derived directly from the execution system, it would incorporate the same measures of capability used in execution, the same resource categories, and the same relations connecting the two. (Once D041 has been altered to use aircraft availability targets, a database reflecting this measure could be constructed.) Thus, it would be consistent with D041 or LEVELS/STRAT, and because a new database could be derived each time the execution system is exercised, it would remain consistent. If proper records are kept, an audit trail will exist between programming and execution, since whatever capabilities the programmers decide upon can be traced back to a particular set of inputs and assumptions used in the execution system. This would tend to foster implementation of the programmer's intent.

With such a tool, a programmer could build a priority scheme ranking incremental activities and capabilities of different weapon systems. Starting with minimal acceptable capabilities for all weapon systems, the programmer could decide which weapon system's capability it is most important to improve. For example, he might first increase F-15 peacetime flying hours by 5 percent and then would use the aggregate database to estimate the amount by which this would increase the total cost. Next, the programmer might wish to increase the peacetime availability of the C-5 and would again use the aggregate database to estimate the effect of this on the cost of component buys and repairs. The programmer could repeat this process until an entire curve had been defined relating increments of capability to cost; and that curve would express his preference concerning what mix of capabilities the logistics system should plan to support for an" budget level. Of course, another programmer might have other preferences and would therefore construct a different curve.

Using the aggregate database, we expect that a programmer would develop certain insights he could not readily obtain in any other way. He would gain an appreciation for which activities and capabilities are the most important drivers of cost. Here we do not refer only to weapon system activities and capabilities, but activities of the logistics system as well. For example, which weapon system activities require the most stock, measured in total dollar value, to fill the transportation pipelines? These insights could suggest directions in which to look for improvements in both operational and logistics performance.

Such a database would merely provide to the PPB system, as well as to other users, a method for reproducing the aggregate dollar requirements projected by the execution system for individual weapon systems, without requiring the execution system to be exercised repeatedly. This does not solve all the problems of D041 or LEVELS/STRAT as providers of aggregate information. For example, neither D041 nor LEVELS/STRAT is designed to forecast component requirements years into the future. They assume that the demand rates, transportation times, repair times, and even the identities of the items in use can be accurately forecast many years into the future.

(Generally the demand rates, etc., are assumed to remain constant at their current values.) For day-to-day management decisions, this assumption may be adequate. But decisions must be made in the PPB process two or more years before they can affect available resources. During that time, many changes will occur that will affect the requirements for individual components, and although these changes may not be predictable in detail, their aggregate effect on budget projections should be predictable in part. But because D041 and LEVELS/STRAT make no attempt to address this problem, and because the ORACLE methodology constructs the aggregate database in such a way as to mimic these systems, ORACLE also fails to address this problem.

4.2. CONSTRUCTING A PROTOTYPE OF ORACLE

We developed the ORACLE methodology to abstract such an aggregate database from D041 or LEVELS/STRAT. We have built a prototype of ORACLE based on a special test version of D041 that we constructed especially for this purpose. There are only two important differences between the test version and the real thing. First, the test version uses an aircraft availability objective in place of the backorder objective currently used in D041 (but soon to be replaced). Second, the test version calculates only part of the war reserve requirement (PWRM), and includes the rest as an additive (OWRM). Thus in our prototype, other war reserves are not related to any programmed quantities. We will describe the test version of D041 in detail as we describe the ORACLE methodology that is based upon it.[1]

The procedures for constructing the aggregate database are designed for (relatively) easy incorporation in D041 or LEVELS/STRAT. These systems process items sequentially (recall that "items" are synonymous with "components") and have little capability to look back and forth among items. Most of the procedures described in this section can be executed during a single pass through the items, with no need to look

[1]Our prototype of ORACLE therefore does not mimic the production version of D041. It follows that implementing ORACLE in the production version of D041 will require some modifications to the ORACLE equations, and a subsequent computer programming effort. Implementation of ORACLE is further complicated by the modification to D041 that is occurring now, which will replace the backorder criterion with an aircraft availability criterion.

simultaneously at two or more items. A few of the procedures, those concerning peacetime safety levels and PWRM, may involve two passes through the items. But two passes are required in the present D041 computation to compute these quantities.

As described in Sec. 2, D041 develops the net buy and repair requirements for a component by first building the gross requirement from a variety of individual pieces and then subtracting different types of assets until either the assets or the requirement is exhausted. The pieces that make up the gross requirement include operating requirements (components that fail and must be replaced), pipeline requirements (components in transit or repair), safety levels (to cover random fluctuations in pipeline contents), WRM requirements (to cover activities specified in wartime planning scenarios), and additives (anything not in another category). Assets include serviceable components on hand, components repairable at base level, components repairable at depot level, etc. (Most of the operating requirement--i.e., components that fail--can be repaired at base or depot level and returned to service.) D041 reports these computations in a standard product called the "item computation worksheet."

The ORACLE database contains the item computation worksheet entries aggregated across components. Entries are weighted by the purchase price of the component, so the results express the total dollar value of components. (For aggregating the depot repair requirement, we also use the depot repair cost as a weight.) Entries may be aggregated over any group of components, e.g., all F-xx components, or all navigational instruments. These aggregated figures may indicate potential problems soon to face the logistics system--for example, that a high and growing value of F-xx components will be tied up in transit between the flight line and the depot.

In D041, the average number of a component tied up in transit from base to depot is proportional to its level of flying activity. Similarly, the number that fail and must be replaced in an interval of time (the operating requirement) is proportional to the hours flown in that interval. ORACLE aggregates these and other proportionality factors in the same way as the worksheet entries. The aggregated factors indicate which activities by which weapon systems give rise to

large requirements. Moreover, the factors can be combined to determine average transit and repair times for groups of components, average condemnation percentages, average depot repair percentages, etc. These quantities may show, for example, the degree to which a high value of components in transit from base to depot is due to: (a) a high percentage of components being repaired at the depot rather than the base; (b) a long transportation time; (c) a high rate of failures per flying hour; or (d) a lot of flying activity.

Finally, for each component, ORACLE calculates the derivatives of its required purchases and repairs with respect to any programmed quantities that are inputs to D041 or LEVELS/STRAT.[2] Then ORACLE aggregates these derivatives the same way as the worksheet entries. In the Air Force, program inputs include peacetime flying hours, programmed depot maintenance (PDM) of aircraft, engine overhauls, peacetime aircraft availabilities, and such wartime parameters as sortie rates and attrition rates. (Because of differences between LEVELS/STRAT and D041, the Navy list of program inputs is not as rich.) To rapidly assess the resource implications of changing the programs (as the PPB process must), one multiplies the program change by the appropriate aggregated derivative. If there is more than one program change, one computes the resource implications of each and adds them together. Or one may back-calculate to determine what reduction in, say, 1987 programmed F-16 peacetime flying hours will yield a needed savings in the 1985 budget, or what reduction in the planned 1987 F-16 wartime sortie rate will offset the 1985 budgetary impact of an increase in 1987 F-16 peacetime flying hours.

The derivatives, however, differ from the previously mentioned proportionality factors for some parts of the requirements in that they provide only an approximate way to reproduce in aggregate the results of a detailed, item-by-item computation. We know that the approximation is a very good one for "sufficiently small" changes in program quantities, but it requires a practical test to determine how large the program changes can be and still be "sufficiently small" that the approximation

[2]The derivatives are the rates of change in dollars required for purchases or repairs as programmed quantities are varied by small amounts.

remains adequate. Looking ahead to Sec. 5, however, we have found that the approximations using derivatives are very good indeed for surprisingly large program changes. For example, peacetime flying hours can be changed by as much as 50 percent, and the derivatives will generally provide estimates of buy and repair requirements that are within 1 or 2 percent of the results from an item-by-item computation.

4.3. FACTORS IMPORTANT FOR ESTIMATING COMPONENT REQUIREMENTS

In Table 1 are various key factors on which the computation depends. This table is our own recreation, in abbreviated form, of a product of D041 that is provided to each item manager for his items at the start of each quarterly D041 computation cycle. The actual product contains a few more factors than Table 1, and for some factors contains several values forecast for various future years. The item manager must review these factors and suggest changes and corrections as needed. This is part of the process that attempts to keep the D041 database current and correct.

The item is identified at the top of Table 1 by its subgroup master stock number and a (frequently cryptic) ten character name. Then the application and quantity per application are given. Items in our extract from the D041 database have only one application; the particular item given in the table is peculiar to the C-141. (It may--probably does--serve as a part for most or all of the different series of C-141.) On the average there is one of this item on each C-141. This may mean that every C-141 has one of these parts, or it could mean that half the C-141s each have two of them, or some other combination. (Admittedly, it is unlikely that a C-141 would have two tail cones, but we are concerned with the principle of the thing.)

In the complete D041 database, items have several kinds of applications. Items may be applied to an aircraft, as is this example item, or to an engine, or a missile, a piece of test equipment, ground support equipment, etc. All of these are considered "end items," as they do not in turn have applications to yet other items. In our prototype the only end items we have dealt with are seven aircraft and the five engines they use. In D041, an item may also be applied to

Table 1: Key Factors for Computing Item Requirements

REPORT FOR ITEM 1560002251069JH TAIL CONE

APPLICATION = C141 QPA = 1.00

SHORT NAME	DESCRIPTION	VALUE
TOIMDR	TOTAL OIM DEMAND RATE	0.000386
OIMDDR	OIM DEPOT DEMAND RATE	0.000077
OIMBRR	OIM BASE REPAIR RATE	0.000309
CNDB	BASE CONDEMNATION PERCENT	0.00
BOSTD	BASE ORDER-AND-SHIP DAYS	14
BRCD	BASE REPAIR CYCLE DAYS	5
TDRCD	TOTAL DEPOT REPAIR CYCLE DAYS	46
REPNP	PDM NON-JR REPAIR PERCENT	100
RPLNP	PDM NON-JR REPLACEMENT PERCENT	1
CNDJP	PDM JR CONDEMNATION PERCENT	0
REPNE	EOH NON-JR REPAIR PERCENT	0
RPLNE	EOH NON-JR REPLACEMENT PERCENT	0
CNDJE	EOH JR CONDEMNATION PERCENT	0
CNDDO	DEPOT OVERHAUL CONDEMNATION PERCENT	36
NJRSLD	NON-JR STOCK LEVEL DAYS	14
JRSLD	JR STOCK LEVEL DAYS	0
REPCST	UNIT REPAIR COST	$2,254.55
PRICE	UNIT PRICE AT LAST PURCHASE	$12,173.00
ALT	ADMINISTRATIVE LEAD TIME MONTHS	7
PLT	PRODUCTION LEAD TIME MONTHS	9

another recoverable component--i.e., it can be a subcomponent. But as mentioned above, we have not considered any such items in our prototype.

Next are OIM demand rates. In the course of calculating the gross requirement for an item, D041 multiplies these rates by the item's activity at the flight line. The item's activity derives from the activity of the end items--in our case, aircraft and engines--to which it is applied, and their activity is measured in terms of flying hours. Thus, the demand rate is estimated by dividing the observed removals

over a given interval of time (typically two years) by the hours flown in the same interval. Three demand rates are given: total removals per flying hour; the number of items per flying hour that were returned to the wholesale echelon as Not Reparable This Station (NRTS); and total base-level attempted repairs per flying hour. The first is the sum of the other two.

Not all repairs attempted at base level will be successful, and the fraction that is not successful will be condemned and replacements will be requisitioned from the wholesale echelon. There are very few condemnations at base level; more than 99 percent of items removed at the flight line are either successfully repaired or coded NRTS and sent to wholesale.

Two pipelines are associated with the base requirements that are related to OIM activity--the base repair cycle pipeline, and the order-and-ship pipeline. Each of these pipelines has a length measured in days. Similarly, the wholesale echelon has a pipeline, whose length is the time (in days) necessary to ship a failed item from the base to wholesale and to repair the item at wholesale. This time is called the "total depot repair cycle days," despite the fact that it includes time for transportation as well as for depot-level repair. These times are typically standards rather than actual measured times.

Next come factors relating to depot-level maintenance (DLM) activities. The DLM activities we are interested in, because they are the activities that give rise to demands for recoverable components, include PDM of aircraft and Programed Engine Overhauls (EOH). In D041, a third program is considered, the "management of items subject to repair," or MISTR, program. Each component has a MISTR program; indeed, the depot repair requirements over time that D041 calculates for a component is that component's future MISTR program. If a component has subcomponents, then during the repair of the parent component a failure of a subcomponent may be discovered. There are factors in the D041 database that allow one to estimate how often a failed subcomponent will be discovered during the repair of parent components, but we do not include these MISTR-related factors in Table 1, because as mentioned

above, we have not considered any components that are indentured to other recoverable components.[3]

Each DLM program is really two programs in one. Some of the components removed from an aircraft undergoing PDM, or from an engine undergoing overhaul, will be turned in to the supply system in exchange for serviceable replacements. The item may then be scheduled into repair as a separate job. Other components may be sent directly from the PDM or EOH line to the maintenance shop for repair and returned to the PDM or EOH line without supply ever seeing them. Only if the item must be condemned will a replacement be requisitioned from supply. These two possibilities are referred to as "nonjob routed" (i.e., repaired as a separate job) and "job routed" (i.e., repaired as part of the same job), respectively. D041 learns only of transactions that involve supply; so it has complete information on nonjob-routed items but learns only of condemnations of job-routed items.

To estimate the demands that arise from each DLM program, D041 contains three factors. The first is the "nonjob-routed repair percent," which is the percentage of the DLM program for this item that generates nonjob-routed demands. The complementary percentage generates job-routed demands. From Table 2, for example, we observe that the PDM nonjob-routed repair percentage for the C-141 tail cone is 100. This means that for 100 percent of all C-141s undergoing PDM, if the tail cone must be repaired, it will be repaired nonjob routed. If this percentage were, say, 50, then for only half the C-141s undergoing PDM would the necessary tail cone repairs be performed nonjob routed. The other 50 percent would be job routed.

The second factor is the nonjob-routed replacement percentage, which measures the percentage of items in the nonjob-routed part of the program that will be removed and replaced as part of the depot-level maintenance activity. From Table 2, the PDM nonjob-routed replacement percentage for the C-141 tail cone is 1. Thus, of all the tail cones from C-141s in PDM that might be repaired nonjob routed, only 1 percent

[3]Treatment of indentured items presents no difficulty in principle but could be cumbersome computationally. But it is not much more cumbersome to calculate derivatives of indentured item requirements than to calculate their requirements in the first place. See Appendix A, Sec. A.3., for further discussion.

Table 2: Total Gross Requirements for a Single Item

REPORT FOR ITEM 1560002251069JH TAIL CONE APPLICATION = C141 QPA = 1.00

FISCAL YEAR:	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
OIM CUMULATIVE PROGRAM	72438.	145259.	221107.	297479.	374364.	451399.	528434.	605469.	682504.	759539.
OIM OP RQMT	27.96	56.07	85.35	114.83	144.50	174.24	203.98	233.71	263.45	293.18
OIM BASE O&ST RQMI	0.21	0.22	0.22	0.23	0.23	0.23	0.23	0.23	0.23	0.23
OIM BASE R/C RQMI	0.31	0.31	0.32	0.32	0.33	0.33	0.33	0.33	0.33	0.33
OIM SAFETY LEVEL	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
NEGOTIATED S/L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL OIM BASE S/L	0.52	0.52	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
OIM DEPOT P'LINE	0.70	0.71	0.74	0.74	0.75	0.75	0.75	0.75	0.75	0.75
OIM DEPOT S/L	3.44	3.45	3.52	3.53	3.55	3.55	3.55	3.55	3.55	3.55
TOTAL DEPOT OIM STOCK	4.14	4.16	4.26	4.27	4.29	4.30	4.30	4.30	4.30	4.30
PDM CUMULATIVE PROGRAM	64.	128.	192.	256.	320.	384.	448.	512.	576.	640.
PDM NJR RQMT	0.64	1.28	1.92	2.56	3.20	3.84	4.48	5.12	5.76	6.40
PDM JR RQMT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PDM NJR S/L	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
PDM JR S/L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EOH CUMULATIVE PROGRAM	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH NJR RQMT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EOH JR RQMT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EOH NJR S/L	0.00	0.00	0 00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EOH JR S/L	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL OVHL CNDMN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL OVHL S/L	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
PREPOS WRM RQMT	10.82	10.82	10.82	10.82	10.82	10.82	10.82	10.82	10.82	10.82
OTHER WRM RQMT	27.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00
ADDITIVE RQMT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL AF GROSS RQMT	71.11	99.88	129.92	160.06	190.40	220.78	251.15	281.53	311.91	342.28

actually need repair. The demands for C-141 tail cones that the nonjob-routed part of the C-141 PDM program places on the supply system can therefore be estimated as the product of these two factors (1 percent of 100 percent), multiplied by the QPA (average quantity per application) and by the number of C-141s undergoing PDM.

The third factor is the job-routed condemnation percentage, which measures the percentage of items in the job-routed part of the program that will be condemned and thus give rise to requisitions for serviceable items from supply. Table 2 shows that none of the tail cones from C-141s undergoing PDM are condemned during job-routed repair; but it has already shown that 100 percent of the C-141 tail cones from PDM are processed nonjob routed, so there are no opportunities for job-routed condemnations. If some C-141 tail cones underwent job-routed repair, only the unsuccessful repairs (i.e., condemnations) would be recorded for D041. The tail cones that were successfully repaired would be returned directly to the C-141s from which they had been taken, and the D041 system would never be informed of the repair. Table 1 shows these three factors for the PDM program and the EOH program.

Not all components that the depot attempts to repair are repaired successfully. Some are condemned, and the next factor in Table 1 is the depot overhaul condemnation percentage. In contrast with base-level repair, a substantial fraction of many components is condemned at the depot. This condemnation percentage applies only to components that the supply system itself schedules into the repair process. It does not, therefore, apply to job-routed repairs. To find total condemnations, one must add job-routed condemnations to this percentage of the components scheduled into repair by the supply system.

Both the job-routed and nonjob-routed parts of each DLM program have associated repair pipelines in the depot. D041 contains factors, called the nonjob-routed and job-routed stock-level days, respectively, which measure the lengths of these pipelines. They are assumed to be the same length for each DLM program.

Table 1 also contains factors that indicate the administrative and production lead times for the item, which show how far in advance of need one must begin the process of buying the item, and the costs of repairing the item at the depot or of buying a new item. These factors

are not used directly in the computation of item requirements, but they are important in deciding where to trim budgets and purchase requests.

In the subsections that follow, we will introduce the equations by which the requirements for each component are calculated. When factors from Table 1 appear in these equations, as they frequently will, we will refer to the factors by the names introduced in the left-hand column of the table. For example, where an equation uses the total OIM demand rate, that factor will appear as TOIMDR(i), where the notation TOIMDR is from Table 1, and the subscript "i" denotes the component to which the factor applies.

4.4. OPERATING AND PIPELINE REQUIREMENTS

Table 2 illustrates the calculation of the total gross requirement for an item. During each D041 computation cycle, each item manager receives a D041 product which for each of his items contains essentially the same information to be found in Table 2, plus that found in Table 3. These two tables are thus our recreation of the standard D041 item requirements computation. The item manager receives such tables twice during the computation cycle--once after the initial computation, and once after the final computation (recall that D041 is run twice during the cycle). The first is used to help "scrub" the D041 database; the second is used to help decide how many of each item to buy and repair.

The quarterly D041 exercise begins on a day called the "asset cutoff date"; for the four quarters, the dates are June 30, September 30, December 31, and March 31. On this date, the books of the D104[4] system are closed, and over the ensuing month or so, the information on the inventories and locations of all recoverable components in possession of the Air Force as of that date are collected and compiled.

The columns of Table 2 correspond to points in time one year, two years, etc., following the asset cutoff date. Thus, we have calculated

---

[4]D104 is the Air Force's "Worldwide Stock Balance and Consumption Report," in which data on component inventories and usage at every Air Force base or location are summarized.

Table 3: Asset Application for a Single Item

REPORT FOR ITEM 1560002251069JH TAIL CONE APPLICATION = C141 QPA = 1.00

FISCAL YEAR:	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL AF GROSS RQMT	71.11	99.88	129.92	160.06	190.40	220.78	251.15	281.53	311.91	342.28
SVCBL ASSETS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1ST OVER	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1ST SHORT	71.11	99.88	129.92	160.06	190.40	220.78	251.15	281.53	311.91	342.28
BASE REP GENS	22.38	44.88	68.32	91.92	115.68	139.48	163.29	187.09	210.89	234.70
BASE CNDMN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
POT BASE REPAIR	22.38	44.88	68.32	91.92	115.68	139.48	163.29	187.09	210.89	234.70
2ND OVER	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2ND SHORT	48.73	54.99	61.60	68.14	74.72	81.30	87.87	94.44	101.01	107.58
DEPOT BACKLOG	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
DEPOT REP GENS	6.22	12.46	18.95	25.47	32.03	38.60	45.17	51.74	58.31	64.88
DEPOT CNDMN	4.76	7.01	9.34	11.69	14.05	16.42	18.78	21.15	23.51	25.88
POT DEPOT REPAIR	8.46	12.46	16.60	20.78	24.98	29.18	33.39	37.59	41.80	46.01
4TH OVER	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4TH SHORT	40.27	42.54	44.99	47.36	49.74	52.11	54.48	56.85	59.21	61.58
DUE IN/ON ORDER	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
6TH OVER	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6TH SHORT = BUY RQMT	36.27	38.54	40.99	43.36	45.74	48.11	50.48	52.85	55.21	57.58
ACT. DEPOT REPAIR	8.46	12.46	16.60	20.78	24.98	29.18	33.39	37.59	41.80	46.01

the annual requirements to buy and repair an item ten years beyond asset cutoff.[5] In the D041 system, the requirements to buy and repair components are calculated quarter by quarter (instead of year by year) for 22 to 25 quarters (5-1/2 to 6-1/4 years), plus an additional three-year period called the "retention period." The total time period covered depends on which of the four yearly computations is being considered. The June 30 computation covers the longest time, with successive computations dropping one quarter each until the next June 30 computation arrives and an entire new year is added. Thus, the March 31 computation has the shortest time horizon, and covers only 5-1/2 years plus the three-year retention period. Table 2 uses years, not quarters as its basic time interval (since years are the time intervals used in the PPB), and it carries the computation ten years, not five or six, beyond asset cutoff. As we discussed earlier, the shorter time span covered by the D041 computation is one of the features that prevents it from being an effective provider of inputs to the PPB process.

In this subsection, we will discuss only those lines of Table 2 that correspond to operating and pipeline requirements. In later subsections we will cover safety levels, war reserves, and additive requirements.

4.4.1. Operating and Pipeline Requirements for a Single Item

The first line of Table 2 contains the cumulative OIM program for the item (see the quantity COPIT(i,y) defined by Eq. (1b) below). Note that the program is cumulated across years, so that the entry in the first column is the hours this item is expected to fly in the first year following asset cutoff, the entry in the second column is the hours the item will fly in the first two years combined following asset cutoff, and so on.

---

[5] With an asset cutoff date of March 31, the years are six months out of phase with the fiscal year. To make these years fiscal years, we should have made the first period six months long. But this would have complicated the special version of D041 that we constructed, so we did not do so.

Define:

OIMPG(k,y) = the flying hours programmed for end item k during year y following asset cutoff. Some end items have their OIM activity measured by something other than flying hours, such as squadron months. But this is not the case for the end items considered in our prototype.

QPA(i,k) = the average quantity of item i applied to each end item k (one of the factors given in Table 1).

The cumulative OIM program for end item k can be computed as:

(1a) $$\mathrm{COIPR}(k,y) = \mathrm{Sum}(\mathrm{OIMPG}(k,s) \mid s \leq y)$$

And the cumulative OIM program for item i is:

(1b) $$\mathrm{COPIT}(i,y) = \mathrm{Sum}(\mathrm{QPA}(i,k) * \mathrm{COIPR}(k,y) \mid \text{all } k)$$

In D041, requirements for an item are calculated from the item OIM program COPIT(i,y). But the item OIM program is defined in terms of the programs for end items to which the item in question is applied. We will find it more convenient to bypass the use of the item programs and to express the item requirements directly in terms of the end item programs.

Note that Eq. (1b) involves a sum over all end items k. In fact, the equations later in this subsection are valid for items that have applications to multiple end items, even though we have constructed our prototype of ORACLE using only items with single applications. Single and multiple application items are distinguished, in these equations, only by the fact that multiple application items have nonzero QPA(i,k) for two or more end items k, whereas single application items have only *one nonzero* QPA(i,k).

The second line of the table contains the OIM operating requirement for item i in the various years, which we denote by OIOPR(i,y). As an end item "operates" at the flight line (in our case, operating means flying), components will fail and must be replaced. The number of replacements needed in an interval of time is the operating requirement for that interval. The entry in the first column, line 2, is the expected number of removals of this item at the flight line by the end of the first year, the entry in the second column is the number of removals in the first two years, etc. These quantities are computed using Eq. (2). In this equation, we have assumed that the demand rate remains constant over time. In the event that the item manager has entered forecast values for the demand rate that are not constant over time, the formula becomes somewhat more complex. The quantity TOIMDR(i) is the total OIM demand rate, using the notation introduced in Table 1.

$$\text{(2)} \quad \mathrm{OIOPR}(i,y) = \mathrm{Sum}(\mathrm{TOIMDR}(i) * \mathrm{QPA}(i,k) * \mathrm{COIPR}(k,y) \mid \text{all } k)$$

The items that fail are available to be repaired at either intermediate or depot level. The number that could potentially be successfully repaired at the intermediate (or base) level (denoted PBREP(i,y), for "Potential Base Repairs") can be calculated as:

$$\text{(3)} \quad \mathrm{PBREP}(i,y) =$$

$$\mathrm{Sum}(\mathrm{OIMBRR}(i) * (1 - \frac{\mathrm{CNDB}(i)}{100}) * \mathrm{QPA}(i,k) * \mathrm{COIPR}(k,y) \mid \text{all } k)$$

And the number that could potentially be successfully repaired at the depot is:

$$\text{(4)} \quad \mathrm{PODREP}(i,y) =$$

$$\mathrm{Sum}(\mathrm{OIMDDR}(i) * (1 - \frac{\mathrm{CNDDO}(i)}{100}) * \mathrm{QPA}(i,k) * \mathrm{COIPR}(i,y) \mid \text{all } k)$$

These potential repairs are assets that can be used to offset part of the total gross requirement for an item. The actual repairs may be less than the potential repairs, since no more will be repaired than needed to satisfy the gross requirement. How the actual repairs are calculated is the subject of a later section.

In Eqs. (3) and (4) there appear a number of factors defined in Table 1. These are OIMBRR, CNDB, OIMDDR, and CNDDO.

Next, there are various OIM pipeline requirements. The OIM base order-and-ship time requirement (denoted BOSR(i,y)) is the expected number of items that will be in the order-and-ship pipeline from wholesale to the base in peacetime. The OIM base repair cycle requirement (denoted BRCR(i,y)) is the expected number of items that will be in the base repair cycle pipeline in peacetime. These are proportional to the instantaneous activity rate at the flight line and not to the cumulative OIM program; but the instantaneous programmed rate can be estimated by differencing successive years of the cumulative program. The equations D041 uses to compute these terms follow.

First we define a factor OSRATE(i) that estimates the rate at which items i are either coded NRTS and sent off base or are condemned at base. Either of these two actions will result in a requisition on wholesale supply and hence a requirement for an item to enter the order-and-ship pipeline. This rate is:

$$\mathrm{OSRATE}(i) = \mathrm{OIMDDR}(i) + \frac{\mathrm{CNDB}(i)}{100} * \mathrm{OIMBRR}(i)$$

Using this factor, we estimate the expected order-and-ship pipeline content to be:

$$(5) \quad \mathrm{BOSR}(i,y) = \mathrm{Sum}\left(\frac{\mathrm{BOSTD}(i) * \mathrm{OSRATE}(i) * \mathrm{QPA}(i,k) * \mathrm{OIMPG}(k,y)}{365} \;\middle|\; \text{all } k\right)$$

The expected base repair cycle pipeline is:

$$(6)\quad BRCR(i,y) = Sum\left(\frac{BRCD(i) * OIMBRR(i) * QPA(i,k) * OIMPG(k,y)}{365} \mid \text{all } k\right)$$

See Table 1 for definitions of BOSTD and BRCD.

Next in Table 2 appear entries for the base safety level and the negotiated stock level and the total OIM base stock level. The base safety level will be discussed in the next subsection and the negotiated stock level and all other additive requirements will be identified in Sec. 4.8. The total OIM base stock level is the sum of the OIM operating requirement (Eq. (2)), the base O&ST (Eq. (5)) and repair (Eq. (6)) pipelines requirements, the base safety level, and the negotiated stock level.

The OIM programs also give rise to certain depot-related requirements. There is a requirement for the expected number of items in the transportation pipeline for failed components returning to the depot for repair, and for the expected number of items in repair at the depot that originated as OIM demands. Together, these two pipeline segments are referred to as the "total depot repair cycle pipeline," despite the fact that one of the segments represents transportation. This expected pipeline quantity, which we denote by DORCR(i,y), is proportional to the instantaneous programmed OIM activity rate, as are the base repair cycle and base order-and-ship time requirements. The expression for the expected OIM depot pipeline requirement is:

$$DORCR(i,y) = Sum\left(\frac{TDRCD(i) * OIMDDR(i) * QPA(i,k) * OIMPG(k,y)}{365} \mid \text{all } k\right) \quad (7)$$

(See Table 1 for a definition of TDRCD.)

As the base-related OIM requirements include a safety level, so does the depot-related OIM requirement. This will be discussed in the next subsection. The total depot OIM stock level (line 10 of Table 2) is the sum of the depot pipeline (Eq. (7)) and the depot safety level.

The gross requirements related to each DLM program appear next in Table 2. The computation is essentially the same for the PDM and EOH programs. First comes the cumulative program itself. The entry in a column of this line is calculated using Eq. (8b) (for PDM-related requirements) or Eq. (9b) (for EOH-related requirements), much as the OIM item program is calculated from the programmed OIM activity of its end items.

Define:

PDMPG(k,y) = the number of programmed depot maintenance actions scheduled for end item k during year y following asset cutoff. In this case, end item k must be an aircraft; aircraft undergo PDMs, not engines.

EOHPG(k,y) = the number of engine overhauls scheduled for end item k during year y following asset cutoff. In this case, end item k must be an engine; engines undergo engine overhauls, not aircraft.

The cumulative PDM and EOH programs for end item k can be computed as:

(8a) $$\mathrm{CPDPR}(k,y) = \mathrm{Sum}(\mathrm{PDMPG}(k,s) \mid s \le y)$$

(9a) $$\mathrm{CEOPR}(k,y) = \mathrm{Sum}(\mathrm{EOHPG}(k,s) \mid s \le y)$$

And the cumulative PDM and EOH programs for item i are:

(8b) $$\mathrm{CPPIT}(i,y) = \mathrm{Sum}(\mathrm{QPA}(i,k) * \mathrm{CPDPR}(k,y) \mid \text{all } k)$$

(9b) $$\mathrm{CEPIT}(i,y) = \mathrm{Sum}(\mathrm{QPA}(i,k) * \mathrm{CEOPR}(k,y) \mid \text{all } k)$$

In D041, the gross requirements for an item are calculated from the various item programs, such as the OIM item program defined above and the PDM and EOH item programs defined here. But the item programs are defined in terms of the programs for end items. We will find it more convenient to bypass the use of the item programs and to express the item requirements directly in terms of the end-item programs.

Both the job-routed and nonjob-routed parts of the PDM and EOH programs give rise to operating requirements, which are proportional to the cumulated program. Again, an operating requirement for a given interval of time is the number of items found to need replacement in that interval. Both parts of the program also give rise to level requirements that are proportional to the instantaneous rate of programmed activity. Depot-level maintenance programs are assumed not to have any associated uncertainties in demand, and hence no safety levels are provided. Thus, for each DLM program there are four quantities to calculate, the nonjob-routed and job-routed operating requirements and the nonjob-routed and job-routed stock-level requirements. For the PDM program, we denote these quantities by PNOR(i,y), PJOR(i,y), PNSR(i,y), and PJSR(i,y), respectively. For the EOH program, we denote them ENOR(i,y), EJOR(i,y), ENSR(i,y), and EJSR(i,y). For each DLM program, these are the quantities that appear in the four lines of Table 2 immediately following the cumulative program. The equations for calculating these quantities are:

(10) PNOR(i,y) =

$$\text{Sum}\left(\frac{\text{REPNP(i)}}{100} * \frac{\text{RPLNP(i)}}{100} * \text{QPA(i,k)} * \text{CPDPR(k,y)} \mid \text{all k}\right)$$

(11) PJOR(i,y) =

$$\text{Sum}\left(\left(1 - \frac{\text{REPNP(i)}}{100}\right) * \frac{\text{CNDJP(i)}}{100} * \text{QPA(i,k)} * \text{CPDPR(k,y)} \mid \text{all k}\right)$$

(12) PNSR(i,y) =

$$\text{Sum}\left(\frac{\text{NJRSLD(i)} * \dfrac{\text{REPNP(i)}}{100} * \dfrac{\text{RPLNP(i)}}{100} * \text{QPA(i,k)} * \text{PDMPG(i,y)}}{365} \mid \text{all k}\right)$$

(13) PJSR(i,y) =

$$\mathrm{Sum}\left(\frac{JRSLD(i) * \left(1 - \frac{REPNP(i)}{100}\right) * \frac{CNDJP(i)}{100} * QPA(i,k) * PDMPG(k,y)}{365} \;\middle|\; \text{all } k\right)$$

(14) ENOR(i,y) =

$$\mathrm{Sum}\left(\frac{REPNE(i)}{100} * \frac{RPLNE(i)}{100} * QPA(i,k) * CEOPR(k,y) \;\middle|\; \text{all } k\right)$$

(15) EJOR(i,y) =

$$\mathrm{Sum}\left(\left(1 - \frac{REPNE(i)}{100}\right) * \frac{CNDJE(i)}{100} * QPA(i,k) * CEOPR(k,y) \;\middle|\; \text{all } k\right)$$

(16) ENSR(i,y) =

$$\mathrm{Sum}\left(\frac{NJRSLD(i) * \frac{REPNE(i)}{100} * \frac{RPLNE(i)}{100} * QPA(i,k) * EOHPG(i,y)}{365} \;\middle|\; \text{all } k\right)$$

(17) EJSR(i,y) =

$$\mathrm{Sum}\left(\frac{JRSLD(i) * \left(1 - \frac{REPNE(i)}{100}\right) * \frac{CNDJE(i)}{100} * QPA(i,k) * EOHPG(k,y)}{365} \;\middle|\; \text{all } k\right)$$

Next in Table 2 are the total overhaul condemnations and total overhaul stock levels. The condemnations are the sum of job-routed condemnations from the PDM and EOH programs (Eq. (11) plus Eq. (15)). The stock level is the sum of both job-routed and nonjob-routed stock levels from the PDM and EOH programs (Eqs. (12), (13), (16), and (17)), plus a quantity called the "Depot Floating Stock Level," which is found in the D041 database and which is not calculated from any factors or programs.

The PDM and EOH operating requirements also yield items subject to depot-level repair, which can help to meet some of the requirement. We denote the potential depot repairs of items from PDM by PPDREP(i,y), and those from EOH by PEDREP(i,y). The equations for computing these quantities are:

(18) PPDREP(i,y) =

$$\text{Sum}\left(\frac{\text{REPNP(i)}}{100} * \frac{\text{RPLNP(i)}}{100} * \left(1 - \frac{\text{CNDDO(i)}}{100}\right) * \text{QPA(i,k)} * \text{CPDPR(k,y)} \mid \text{all k}\right)$$

(19) PEDREP(i,y) =

$$\text{Sum}\left(\frac{\text{REPNE(i)}}{100} * \frac{\text{RPLNE(i)}}{100} * \left(1 - \frac{\text{CNDDO(i)}}{100}\right) * \text{QPA(i,k)} * \text{CEOPR(k,y)} \mid \text{all k}\right)$$

Again, these potential repairs are assets that can offset some of the requirements. How assets are applied against requirements is the subject of a later subsection.

Next in Table 2 come three lines describing the requirement for prepositioned war reserves, the requireme t for other war reserves, and additive requirements. The calculation of these requirements, as well as the final computation of the total gross requirement, will be discussed in later subsections.

4.4.2. Aggregating Operating and Pipeline Requirements

Information about individual item requirements is useful in managing the individual item but not directly useful (except perhaps for a very few, very costly items) in the PPB process. But it would be useful in the PPB process to know about the requirements for all items related to a given weapon system, each item being valued at its purchase price, PRICE(i) (using the notation from Table 1). (Alternatively, it may sometimes be useful to value items, not at their purchase price but at their repair cost, REPCST(i).) This is easy to obtain for the operating and pipeline requirements. For example, denote by BOSRD(y) the dollar value of the base order-and-ship pipeline requirement in year y following asset cutoff. Then:

$$\text{(20)} \qquad \text{BOSRD}(y) = \text{Sum}(\text{PRICE}(i) * \text{BOSR}(i,y) \mid \text{all } i)$$

If we substitute the expression for BOSR (Eq. (5)) into the expression for BOSRD (Eq. (20)), we see that the total value of all items tied up in the order-and-ship pipeline can be expressed as a linear function of programmed OIM activities. Thus, one may define a factor, which we denote by OSTF(k), that tells how many dollars worth of stock are expected to be in the OST pipeline per flying hour of each end item k. The expression defining OSTF(k) is:

$$\text{(21)} \qquad \text{OSTF}(k) = \text{Sum}\left(\frac{\text{PRICE}(i) * \text{BOSTD}(i) * \text{OSRATE}(i) * \text{QPA}(i,k)}{365} \;\middle|\; \text{all } i\right)$$

We have assumed that none of the factors from Table 1 depends on the year y and so neither does OSTF(k). But if the item manager has provided forecasts for any factors that vary with time, it is possible to define year-specific factors OSTF(k).

Given this factor, it is possible to determine the effect of an OIM program change on the dollar value of the order-and-ship pipeline content, without repeating an item-by-item computation. In fact, given any number of programmed flying hours OIMPG(k,y), we can compute:

(22) BOSRD(y) = Sum(OSTF(k) * OIMPG(k,y) | all k)

Innocuous though it may seem, Eq. (22) has important implications for ORACLE's database. The brute force method for computing BOSRD(y) for a variety of different OIM programs for different end items is to compute BOSR(i,y) using Eq. (5) item by item for each program and then sum the results across items using Eq. (20). Instead, it is possible to compute the factors OSTF(k) for each end item using Eq. (21) and to do it just once. Thereafter, one may use Eq. (22) to compute BOSTD(y) for any number of different end-item programs, never having to perform another item-by-item computation. The same result will be obtained by either procedure, but the use of Eq. (22) offers enormous economies. In our extract from the D041 database, there are nearly 1000 components for the F-4. Thus, once the factors OSTF(k) have been computed, the use of Eq. (22) offers a thousandfold reduction in effort in computing BOSRD(y).

All terms for which we have presented equations in Sec. 4.4 are proportional to programmed OIM, PDM, or EOH activities of various end items. Operating requirements are proportional to cumulated programs, and expected pipeline requirements are proportional to the programmed activity rates themselves. Thus, the same aggregation procedure works for them as worked for the order-and-ship pipeline, and the same economies can be obtained in computing total dollar values of these requirements. There will be factors to be multiplied not only by programmed OIM activities, but by PDM and EOH activities as well.

4.5. OIM SAFETY LEVELS

4.5.1. The Aircraft Availability Method for Computing Safety Levels

The basic notion underlying all methods for computing OIM safety levels is that the numbers of items in the base-related and depot-related OIM pipelines in peacetime are random. In Sec. 4.4, Eqs. (5), (6), and (7), we estimated the expected values of these numbers, but the observed value at any time is unlikely to match the expected number. There will be periods in which removals of an item at the flight line exceed expectation, and during the intervals immediately following these

periods, the pipelines will contain more items than usual. The safety stocks are intended to provide this incremental pipeline content. Were it not for safety stock, this increment would have to come from WRM or stock on the aircraft themselves.

It is not possible to provide absolute protection with a finite budget, so the problem of calculating safety levels becomes one of determining the combination of items that will provide the greatest level of protection for a given amount of money, or equivalently a given level of protection for the least amount of money. Clearly, how one wishes to calculate safety levels will depend on how one measures the level of protection, or to put it another way, on how one measures the performance of the component support system.

Efforts are currently under way to implement a method in D041 for calculating safety levels that we will call the "aircraft availability" method. This method attempts to assess the effect that shortages of stock will have on the number of aircraft available to fly. Because this appears to be the method of the future--it is the one adopted for use in WARS as well as being chosen for implementation in D041--we have developed our prototype ORACLE to reflect an execution methodology using it. A discussion of this method, including the assumptions underlying it and some variations of it, may be found in Appendix B.

The method we have implemented makes use of the following assumptions. First, war reserve stocks will not be drawn upon in peacetime, and all additive stocks and negotiated levels will be used for whatever purpose originally justified them, so that only the expected pipeline contents plus the safety levels are available to satisfy peacetime demands. Second, we assume that cannibalization actions occur whenever they would result in an additional aircraft being available--the "full cannibalization" assumption. The alternative is to assume no cannibalization; no doubt the truth is in between.

Third, we assume that the numbers of items found in the various pipeline segments are random variables having Normal distributions. This distribution has many nice, well understood properties, including the one that, once the expected number of items in a pipeline becomes substantial (e.g., ten or so), many other distributions closely resemble the Normal distribution with the same mean and variance. We denote by

f(x) the probability density function for a Normal random variable with zero mean and unit variance, and by F(x) the cumulative distribution for the same variable. That is:

$$f(x) = \frac{1}{\mathrm{SQRT}(2 * \mathrm{PI})} * \exp(- x^2/2)$$

$$F(x) = \int_{-\mathrm{inf}}^{x} f(y)\, dy$$

The base safety level cannot be treated as a single pool of stock, for it is divided among several users. Even if at a particular time, one user happens to have a serviceable item on the shelf, he will not (we assume) use it to support a less fortunate user who has a shortage of the same item. This is standard Air Force policy, although it is occasionally violated for some critically short items, and it is the assumption made in D041. It is also almost necessarily the policy of the Navy, since moving things from one deployed aircraft carrier to another is difficult. We let:

USR(i,y) = number of users of item i during year y following asset cutoff.

In the D041 database, there is a datum associated with each item called "number of users." We have not used it because we are unsure just how to interpret it. One perplexing aspect of D041's number of users datum is that it is frequently zero. Thus, in the special version of D041 we constructed to test the ORACLE methodology, we take the number of users of an item to be the number of squadrons possessing the end item to which it is applied. For an F-15 item, for example, the number of users is the number of F-15 squadrons. For an F100 engine item, the number of users is the sum of the F-15 and F-16 squadrons, since the F100 engine is used on both aircraft. The mean number of items per user in the base pipelines is (using Eqs. (5) and (6)):

$$BMEAN(i,y) = \frac{BOSR(i,y) + BRCR(i,y)}{USR(i,y)}$$

We assume that the variance-to-mean ratio number three, VTMR, for each item is known. For simplicity, we have made this parameter the same for every item in our prototype, although this assumption is not necessary in order to make the method work. Thus the variance in the base pipeline content is:[5]

$$BVAR(i,y) = VTMR * BMEAN(i,y)$$

We also assume that the distribution of items in the wholesale pipeline is Normal, with mean (from Eq. (7)) and variance (by analogy with the variance of the base pipeline distribution) of:

$$WMEAN(i,y) = DORCR(i,y)$$

$$WVAR(i,y) = VTMR * WMEAN(i,y)$$

We denote by BSSR(i,y) the total base safety-stock requirement for all users of item i in year y following asset cutoff, and by WSSR(i,y) the wholesale safety-stock requirement, also for item i in year y. These are the quantities we wish to determine. We suppose that each user possesses A(k) end items of type k, k being the end item to which item i is applied. In our test version of D041, we calculate safety stock separately for the set of items applied to each end item. As an alternative we could calculate safety stocks for engine components as part of the safety stock relating to the aircraft that use the engine. Because an engine may be used by several different aircraft, this

---

[5]We refer here to the variance-to-mean ratio of the number of items in a pipeline segment. This is in agreement with the use of variance-to-mean ratios in D041. We are advised by one of our reviewers that the relation of this variance-to-mean ratio to, for example, the variance-to-mean ratio of the demand rate estimate is subtle and depends on the assumptions one makes about repair and transportation time distributions. The same reviewer advises us that little work has been published exploring this and related questions.

approach would require that we address the problem of common items, which we have not done (but see Appendix A). At this time, we do not know how the Air Force intends to treat safety stocks of engine components when the availability objective has been incorporated in D041.

We also suppose that targets have been set specifying how well the safety levels must support the end item: The safety stocks must ensure that there will be at least a user-specified fraction of aircraft available (denoted TFMCS(k)) with at least a user-specified probability (denoted TPROB(k)), and to do so at minimum cost. An alternative formulation will maximize the probability of meeting the target aircraft availability given a fixed budget. The two formulations give precisely the same answers, in the sense that if either the probability or the target availability is the same for both, then the other will also be the same, and the safety levels for every component will be the same as well. Safety-stock requirements must be recalculated for each year of the D041 projection, since the number of users and the OIM program may change. Conceivably, TFMCS(k) and TPROB(k) could also change from year to year, but we have taken them to be constant.

Finally, we do not allow safety levels to be negative. The reason for this prohibition is fully explained in Appendix B, but briefly, allowing the safety levels of a component to be negative can guarantee that some aircraft will always lack that particular component. Indeed, if the safety levels of a component are sufficiently large negative numbers, there may not be sufficient stocks of that component to render all aircraft simultaneously Fully Mission Capable (FMC), even if all components in the system could be collected and delivered to the flight line. Prohibiting negative safety levels avoids this undesirable event. To describe this optimization problem precisely, it is convenient to define the following:

$$b(i,y) = \frac{\dfrac{BSSR(i,y)}{USR(i,y)} + A(k) * QPA(i,k) * (1 - TFMCS(k))}{SQRT(BVAR(i,y))}$$

$$w(i,y) = \frac{WSSR(i,y)}{SQRT(WVAR(i,y))}$$

Then the following formula, which is derived in Appendix B, estimates the probability that a set of safety levels for all items enables the end item k to achieve the target FMCS fraction. This formula assumes that cannibalization is allowed (PC denotes "Probability under Cannibalization"). The target FMCS fraction is TFMCS(k). The function F(.) was defined earlier to be the cumulative normal distribution.

$$PC(TFMCS(k),k) = Prod(F(b(i,y)) * F(w(i,y)) \mid \text{all } i)$$

Now we are prepared to develop the specific conditions defining the optimal safety levels. Our formulation of the safety-level problem is:

$$(23)\quad \left\{ \begin{array}{ll} \multicolumn{2}{l}{\text{Minimize } Sum(PRICE(i) * (BSSR(i,y) + WSSR(i,y)) \mid \text{all } i)} \\ \text{s.t.} & Prod(F(b(i,y)) * F(w(i,y)) \mid \text{all } i) \geq TPROB(k) \\ & BSSR(i,y) \geq 0 \quad \text{all } i \\ & WSSR(i,y) \geq 0 \quad \text{all } i \end{array} \right.$$

The variables to be determined are the base and wholesale safety stocks for each item, BSSR(i,y) and WSSR(i,y). These safety stocks affect the expected FMCS aircraft through the quantities b(i,y) and w(i,y). An optimal solution to Problem (23) is a set of nonnegative base and

wholesale safety-stock levels, one for each item, that ensures that the target FMCS aircraft (TFMCS(k)) is met with at least the desired probability (TPROB(k)) at the least possible cost. Note that BSSR(i,y) and WSSR(i,y) depend on the year y as well. Problem (23) is solved for each year for which D041 projects requirements and new safety levels are obtained.

The conditions under which BSSR(i,y) and WSSR(i,y) form an optimal solution are known as the "Kuhn-Tucker," or "optimality" conditions; discussions can be found in Refs. 10 and 11. We first define:

$$g(x) = f(x)/F(x)$$

Then BSSR(i,y) and WSSR(i,y) form an optimal solution to Problem (23) if for some value of u(k,y) (a new parameter called a Lagrange multiplier), the following conditions hold (see Appendix B for a complete discussion):

For each component i, if BSSR(i,y) > 0, then:

$$g(b(i,y)) = \frac{\text{PRICE}(i) * \text{USR}(i,y) * \text{SQRT}(\text{BVAR}(i,y))}{u(k,y) * \text{TPROB}(k)} \tag{24a}$$

For each component i, if BSSR(i,y) = 0, then:

$$g(b(i,y)) \le \frac{\text{PRICE}(i) * \text{USR}(i,y) * \text{SQRT}(\text{BVAR}(i,y))}{u(k,y) * \text{TPROB}(k)} \tag{24b}$$

For each component i, if WSSR(i,y) > 0, then:

$$g(w(i,y)) = \frac{\text{PRICE}(i) * \text{SQRT}(\text{WVAR}(i,y))}{u(k,y) * \text{TPROB}(k)} \tag{24c}$$

For each component i, if WSSR(i,y) = 0, then:

$$\text{(24d)} \qquad g(w(i,y)) \leq \frac{\text{PRICE}(i) * \text{SQRT}(\text{WVAR}(i,y))}{u(k,y) * \text{TPROB}(k)}$$

If u(k,y) > 0, then:

$$\text{(24e)} \qquad \text{Prod}(F(b(i,y)) * F(w(i,y)) \mid \text{all } i) = \text{TPROB}(k)$$

If u(k,y) = 0, then:

$$\text{(24f)} \qquad \text{Prod}(F(b(i,y)) * F(w(i,y)) \mid \text{all } i) \geq \text{TPROB}(k)$$

In our test version of D041, we use a method based on Conditions (24a-f) for determining safety levels. (A similar method is used in the current production version of D041, although there the safety levels are computed to meet a backorder target rather than an aircraft availability target.) The method requires two passes through the component data. Initially, one establishes a number of trial values for the Lagrange multiplier u(k,y). During the first pass through the component data, when data for component i are being processed, one computes the values of BSSR(i,y) and WSSR(i,y) that satisfy (24a) and (24c), respectively, for each of the trial values of u(k,y). If any BSSR(i,y) is negative, it is set to zero and similarly for WSSR(i,y). The function g(x) is such that this action will cause Condition (24b) or (24d), as appropriate, to hold. Once each BSSR(i,y) and WSSR(i,y) has been found, we compute b(i,y), w(i,y), F(b(i,y)), and F(w(i,y)) for each value of u(k,y). The final step in pass number one is to accumulate the products of the probabilities F(b(i,y)) and F(w(i,y)).

By the end of the first pass, these products have been accumulated over all components as in Condition (24e). This results in a table of trial values of u(k,y) and the corresponding probabilities of achieving the target aircraft availability rate. By interpolation, one can

determine the value of u(k,y) for which the probability reaches its desired value. If for all u(k,y), no matter how near zero, the corresponding probabilities are too high, then we choose u(k,y) = 0 and Condition (24f) will hold. In this case, one can show, every safety level will be zero, so for each component i, Conditions (24b) and (24d) will be satisfied.

The second pass repeats the steps of the first but only for the value of u(k,y) that was found to deliver the desired probability.

4.5.2. Derivatives of the Safety Levels

ORACLE needs a way to determine how the safety levels will change if the programmed OIM activity, TFMCS(k), and TPROB(k) are changed. The safety levels do not depend on these quantities in the simple way that pipeline contents and operating requirements depend on programmed activity rates, so instead of an exact equation (such as Eq. (22) above), we will develop an approximate equation based on the derivatives of the safety levels with respect to these quantities. (One might also be interested in estimating the effect of changing the number of users, the variance-to-mean ratio, average pipeline times, etc., but we will not develop such estimates here. The method described below can easily be applied to these other quantities.)

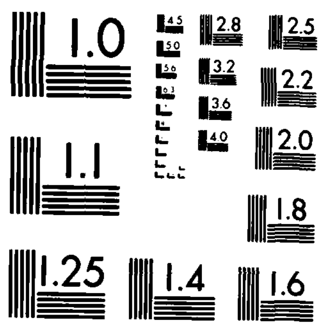
The method we will use to calculate the derivatives is based on a group of mathematical results called "implicit function theorems" [12]. The optimality Conditions (24a-f) relate the optimal values of the safety levels BSSR(i,y) and WSSR(i,y) to the OIM program (previously defined as OIMPG(k,y) for end item k in year y), TFMCS(k), and TPROB(k). It is not possible to write "BSSR(i,y) =" and follow it with some function of OIMPG(k,y), TFMCS(k), and TPROB(k), so BSSR(i,y) is not *explicitly* a function of these quantities. Nevertheless, it is possible to use Conditions (24a-f) to determine the optimal safety levels (as outlined in Appendix B); and if OIMPG(k,y) or TFMCS(k) or TPROB(k) is then changed, it is possible to determine new optimal safety levels that satisfy the modified Conditions (24a-f). So these conditions do describe BSSR(i,y) and WSSR(i,y) *implicitly* as functions of OIMPG(k,y), TFMCS(k), and TPROB(k) (and of other parameters).

If BSSR(i,y) and WSSR(i,y) could be expressed as explicit functions of OIMPG(k,y), TFMCS(k), and TPROB(k), we could compute the sensitivities of the safety levels to changes in these quantities (i.e., the derivatives of the safety levels with respect to these quantities by simply calculating the derivatives of these functions. The implicit function theorem [12] tells us that even though the function is implicit (defined by a set of relations) rather than explicit, we can do the same thing. That is, if we take the appropriate derivatives of Conditions (24a-f), we will obtain conditions from which we can determine the desired derivatives of the safety levels.

The conditions are similar--from the same mold, as it were--regardless of whether they are conditions on derivatives with respect to OIMPG(k,y) or TFMCS(k) or TPROB(k). We will carry out the derivation of these conditions as far as possible in a general context, without committing ourselves as to which of OIMPG(k,y), TFMCS(k), or TPROB(k) is intended. We will denote the derivative of any quantity as that quantity primed. Thus, the derivative of g(x) is g'(x), the derivative of BSSR(i,y) is BSSR'(i,y), the derivative of OIMPG(k,y) is OIMPG'(k,y), etc. At present we are silent concerning whether the derivatives are taken with respect to OIMPG(k,y), TFMCS(k), or TPROB(k). Later, when we must make a choice, we will make the following substitutions when we take derivatives with respect to OIMPG(k,y), we will have:

AD-A152 014 MANAGING RECOVERABLE AIRCRAFT COMPONENTS IN THE PPB (PLANNING PROGRAMMING..(U) RAND CORP SANTA MONICA CA J BIGELOW JUN 84 RAND/R-3094-MIL MDA903-81-C-0381 2/5

UNCLASSIFIED F/G 5/1 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

$$\begin{aligned} OIMPG'(k,y) &= 1 \\ TFMCS'(k) &= 0 \\ TPROB'(k) &= 0 \end{aligned}$$

When we take derivatives with respect to TFMCS(k), we will have:

$$\begin{aligned} OIMPG'(k,y) &= 0 \\ TFMCS'(k) &= 1 \\ TPROB'(k) &= 0 \end{aligned}$$

And when we take derivatives with respect to TPROB(k), we will have:

$$\begin{aligned} OIMPG'(k,y) &= 0 \\ TFMCS'(k) &= 0 \\ TPROB'(k) &= 1 \end{aligned}$$

Until we make the choice, the conditions we derive will contain all three derivatives, OIMPG'(k,y), TFMCS'(k), and TPROB'(k).

The conditions are derived through a rather intricate application of elementary calculus. Suppose for some component i, the optimal base safety level, BSSR(i,y), is positive. Then Condition (24a) holds, and to obtain a condition on BSSR'(i,y) we must differentiate (24a). We do so in several steps starting with the expression on the left-hand side of the equals sign.

$$[g(b(i,y))]' = \frac{dg(b(i,y))}{db(i,y)} * b'(i,y)$$

But, taking into consideration the definition of g(x):

$$\frac{dg(b(i,y))}{db(i,y)} = -g(b(i,y)) * [b(i,y) + g(b(i,y))]$$

Referring back to the definition of b(i,y):

$$b'(i,y) = \frac{\dfrac{BSSR'(i,y)}{USR(i,y)} - A(k) * QPA(i,k) * TFMCS'(k)}{SQRT(BVAR(i,y))} - \frac{1}{2} * b(i,y) * \frac{BMEAN'(i,y)}{BMEAN(i,y)} \tag{25}$$

And referring still further back to the definitions of BMEAN(i,y) and its constituent parts, BOSR(i,y) and BRCRL(i,y) (see Eqs. (5) and (6)):

$$\frac{BMEAN'(i,y)}{BMEAN(i,y)} = \frac{SUM(QPA(i,k) * OIMPG'(k,y) \mid all\ k)}{SUM(QPA(i,k) * OIMPG(k,y) \mid all\ k)}$$

In our special case, each component i is peculiar to a single end item k, so the sums consist of a single term. Then we have:

$$\frac{BMEAN'(i,y)}{BMEAN(i,y)} = \frac{OIMPG'(k,y)}{OIMPG(k,y)} \tag{26}$$

By tracing backward through the steps accomplished so far, one could write a long expression for [g(b(i,y))]', an expression containing no primed quantities other than TFMCS'(k) and OIMPG'(k,y), which we know how to calculate, and BSSR'(i,y), which we are trying to calculate. We therefore temporarily leave the left-hand side of Condition (24a) and take up the right-hand side. But the right-hand side, which we will denote by BRHS, is a simple ratio:

$$BRHS = \frac{PRICE(i) * USR(i,y) * SQRT(BVAR(i,y))}{u(k,y) * TPROB(k)}$$

Using the standard formula from differential calculus for the derivative of a ratio, and rearranging terms a bit, we obtain:

$$BRHS' = BRHS\left[\frac{1}{2} * \frac{BMEAN'(i,y)}{BMEAN(i,y)} - \frac{[u(k,y) * TPROB(k)]'}{u(k,y) * TPROB(k)}\right]$$

It will be convenient not to go further with [u(k,y) * TPROB(k)] at this time.

Now we can equate the derivatives of the left and right sides of Condition (24a) to obtain a condition on BSSR'(i,y). As we have done above, we take the liberty of rearranging terms without showing the intermediate steps. But the only step likely to cause the reader any trouble is noticing that according to Condition (24a),

$$g(b(i,y)) = BRHS$$

This permits one to substitute g(b(i,y)) for RHS at one point in the derivation. We first define the following coefficients:

$$\text{(27a)} \quad \begin{cases} CB1(i,y) = \dfrac{USR(i,y) * SQRT(BVAR(i,y))}{b(i,y) + g(b(i,y))} \\[2ex] CB2(i,y) = \dfrac{USR(i,y) * SQRT(BVAR(i,y))}{2} * \left[b(i,y) - \dfrac{1}{b(i,y) + g(b(i,y))}\right] \\[2ex] CB3(i,y) = USR(i,y) * A(k) * QPA(i,k) \end{cases}$$

Then, the condition implied by (24a) is:

$$\text{(28a)} \quad BSSR'(i,y) = CB1(i,y) * \frac{[u(k,y) * TPROB(k)]'}{u(k,y) * TPROB(k)}$$

$$+ CB2(i,y) * \frac{OIMPG'(k,y)}{OIMPG(k,y)}$$

$$+ CB3(i,y) * TFMCS'(k)$$

Condition (24a) holds only if BSSR(i,y) is positive. If instead, it is zero (i.e., at its lower bound), then the condition implied for BSSR'(i,y) is trivial; the derivative is zero. (The derivative of a constant is always zero.) It will be convenient, however, to express this condition as follows: If BSSR(i,y) is zero, then let:

$$\text{(27b)} \qquad CB1(i,y) = CB2(i,y) = CB3(i,y) = 0$$

Then regardless of whether BSSR(i,y) is zero or positive, Eq. (28a) holds and there is no need for an Eq. (28b).

Next we turn to the wholesale safety levels. The derivation of a condition on WSSR'(i,y) exactly parallels that for BSSR'(i,y). Suppose that for a particular component i, the optimal wholesale safety level is positive. Then we will obtain our condition on WSSR'(i,y) by differentiating Condition (24c). First we differentiate the left-hand side:

$$[g(w(i,y))]' = \frac{dg(w(i,y))}{dw(i,y)} * w'(i,y)$$

$$\frac{dg(w(i,y))}{dw(i,y)} = - g(w(i,y)) * [w(i,y) + g(w(i,y))]$$

$$(29) \qquad w'(i,y) = \frac{WSSR'(i,y)}{SQRT(WVAR(i,y))} - \frac{1}{2} * w(i,y) * \frac{WMEAN'(i,y)}{WMEAN(i,y)}$$

Referring back to the definition of WMEAN(i,y), and thence back to Eq. (7), we find that:

$$\frac{WMEAN'(i,y)}{WMEAN(i,y)} = \frac{SUM(QPA(i,k) * OIMPG'(k,y) \mid all\ k)}{SUM(QPA(i,k) * OIMPG(k,y) \mid all\ k)}$$

As before, because we have considered only components peculiar to single end items, this specializes to:

$$(30) \qquad \frac{WMEAN'(i,y)}{WMEAN(i,y)} = \frac{OIMPG'(k,y)}{OIMPG(k,y)}$$

where k is the end item to which component i is applied.

Turning now to the right-hand side of Condition (24c), we define:

$$\text{WRHS} = \frac{\text{PRICE(i) * SQRT(WVAR(i,y))}}{\text{u(k,y) * TPROB(k)}}$$

Then:

$$\text{WRHS}' = \text{WRHS} * \left[\frac{1}{2} * \frac{\text{WMEAN}'(\text{i,y})}{\text{WMEAN(i,y)}} - \frac{[\text{u(k,y) * TPROB(k)}]'}{\text{u(k,y) * TPROB(k)}}\right]$$

Combining and rearranging the above, and noting that Condition (24c) specifies that g(w(i,y)) = WRHS, we can derive the desired condition on WSSR'(i,y). We first define three coefficients:

$$\text{(27c)} \quad \left\{ \begin{array}{l} \text{CW1(i,y)} = \dfrac{\text{SQRT(WVAR(i,y))}}{\text{w(i,y) + g(w(i,y))}} \\[2ex] \text{CW2(i,y)} = \dfrac{\text{SQRT(WVAR(i,y))}}{2} * \left[\text{w(i,y)} - \dfrac{1}{\text{w(i,y) + g(w(i,y))}}\right] \\[2ex] \text{CW3(i,y)} = 0 \end{array} \right.$$

Then, the condition on WSSR'(i,y) implied by (24c) is:

$$\text{(28c)} \quad WSSR'(i,y) = CW1(i,y) * \frac{[u(k,y) * TPROB(k)]'}{u(k,y) * TPROB(k)}$$

$$+ CW2(i,y) * \frac{OIMPG'(k,y)}{OIMPG(k,y)}$$

$$+ CW3(i,y) * TFMCS'(k)$$

If WSSR(i,y) is zero, then Condition (24c) no longer holds. In this case, though, WSSR'(i,y) is zero. As before, it will be convenient to express this condition as follows. If WSSR(i,y) is zero, we let:

$$\text{(27d)} \qquad CW1(i,y) = CW2(i,y) = CW3(i,y) = 0$$

Then, regardless of whether WSSR(i,y) is positive or zero, Eq. (28c) holds, and there is no need for an Eq. (28d).

Equations (28a) and (28c) are not sufficient for calculating BSSR'(i,y), and WSSR'(i,y), because they both contain forms involving [u(k,y) * TPROB(k)]'. To determine this quantity, we must derive yet another condition, this time from (24e) or (24f). If the optimal value of the Lagrange multiplier u(k,y) is positive, then (24e) holds. Its derivative, with terms rearranged, is:

$$\text{(31)} \quad Sum(g(b(i,y)) * b'(i,y) \mid \text{all } i)$$

$$+ Sum(g(w(i,y)) * w'(i,y) \mid \text{all } i) = \frac{TPROB'(k)}{TPROB(k)}$$

If we substitute b'(i,y) from Eq. (25) and w'(i,y) from Eq. (29) into this expression, and rearrange terms, we obtain the following. First, define the coefficients:

For each component i, if BSSR(i,y) > 0, then:

$$
\text{(32a)}\quad \begin{cases} CB4(i,y) = \dfrac{g(b(i,y))}{b(i,y) + g(b(i,y))} \\[2ex] CB5(i,y) = -\dfrac{1}{2} * CB4(i,y) \\[2ex] CB6(i,y) = 0 \end{cases}
$$

For each component i, if BSSR(i,y) = 0, then:

$$
\text{(32b)}\quad \begin{cases} CB4(i,y) = 0 \\[2ex] CB5(i,y) = -\dfrac{1}{2} * g(b(i,y)) * b(i,y) \\[2ex] CB6(i,y) = -\dfrac{g(b(i,y)) * A(k) * QPA(i,k)}{SQRT(BVAR(i,y))} \end{cases}
$$

For each component i, if WSSR(i,y) > 0, then:

$$
\text{(32c)}\quad \begin{cases} CW4(i,y) = \dfrac{g(w(i,y))}{w(i,y) + g(w(i,y))} \\[2ex] CW5(i,y) = -\dfrac{1}{2} * CW4(i,y) \\[2ex] CW6(i,y) = 0 \end{cases}
$$

For each component i, if WSSR(i,y) = 0, then:

$$
(32d)\quad \begin{cases} CW4(i,y) = 0 \\ CW5(i,y) = -\frac{1}{2} * g(w(i,y)) * w(i,y) \\ CW6(i,y) = 0 \end{cases}
$$

Then, the condition we derive from (31) will be:

$$
\begin{aligned}
(28e)\quad & Sum(CB4(i,y) + CW4(i,y) \mid all\ i) * \frac{[u(k,y) * TPROB(k)]'}{u(k,y) * TPROB(k)} \\
& + Sum(CB5(i,y) + CW5(i,y) \mid all\ i) * \frac{OIMPG'(k,y)}{OIMPG(k,y)} \\
& + Sum(CB6(i,y) + CW6(i,y) \mid all\ i) * TFMCS'(k) \\
& = \frac{TPROB'(k)}{TPROB(k)}
\end{aligned}
$$

Clearly, Eq. (28e) defines [u(k,y) * TPROB(k)]' in terms of quantities that are known and hence provides a way of computing [u(k,y) * TPROB(k)]'.

One final case remains. If u(k,y) is zero, then its derivative and the derivatives of anything multiplied by it are zero. Thus, if u(k,y) zero, the condition becomes:

$$\text{(28f)} \qquad [u(k,y) * \mathrm{TPROB}(k)]' = 0$$

4.5.3. Computing Aggregate Safety Levels and Their Derivatives

The ORACLE database does not require derivatives of the safety levels of individual components. Rather, it needs the derivatives, and the safety levels themselves, aggregated across groups of components. For our prototype we have aggregated across all components applied to the same end item, although as mentioned earlier, other choices are possible. To aggregate, we weight each component's safety levels or derivatives by its price and accumulate over all components applied to the same end item. If we denote by BSSRD(k,y) and WSSRD(k,y) the total dollar value of base and wholesale safety-stock requirements for end item k, respectively, the results for the safety levels would be:

$$\text{(33)} \quad \left\{ \begin{array}{l} \mathrm{BSSRD}(k,y) = \mathrm{Sum}(\mathrm{PRICE}(i) * \mathrm{BSSR}(i,y) \mid \text{all } i) \\ \\ \mathrm{WSSRD}(k,y) = \mathrm{Sum}(\mathrm{PRICE}(i) * \mathrm{WSSR}(i,y) \mid \text{all } i) \end{array} \right.$$

Similarly, the aggregated derivatives, denoted again by primes, are:

$$\mathrm{BSSRD}'(k,y) = \mathrm{Sum}(\mathrm{PRICE}(i) * \mathrm{BSSR}'(i,y) \mid \text{all } i)$$

$$\mathrm{WSSRD}'(k,y) = \mathrm{Sum}(\mathrm{PRICE}(i) * \mathrm{USSR}'(i,y) \mid \text{all } i)$$

Substituting from Eqs. (28a) and (28c) we obtain:

(34a) BSSRD'(k,y) =

$$\text{Sum(PRICE(i) * CB1(i,y) | all i)} * \frac{[\text{u(k,y) * TPROB(k)}]'}{\text{u(k,y) * TPROB(k)}}$$

$$+ \text{ Sum(PRICE(i) * CB2(i,y) | all i)} * \frac{\text{OIMPG'(k,y)}}{\text{OIMPG(k,y)}}$$

$$+ \text{ Sum(PRICE(i) * CB3(i,y) | all i) * TFMCS'(k)}$$

(34b) WSSRD'(k,y) =

$$\text{Sum(PRICE(i) * CW1(i,y) | all i)} * \frac{[\text{u(k,y) * TPROB(k)}]'}{\text{u(k,y) * TPROB(k)}}$$

$$+ \text{ Sum(PRICE(i) * CW2(i,y) | all i)} * \frac{\text{OIMPG'(k,y)}}{\text{OIMPG(k,y)}}$$

$$+ \text{ Sum(PRICE(i) * CW3(i,y) | all i) * TFMCS'(k)}$$

As described above, the D041 system requires two passes through the component data to calculate safety levels. In the first pass, the optimal Lagrange multiplier u(k,y) is chosen. In the second pass, this multiplier is used along with Conditions (24a-d) to determine the optimal safety levels.[6] Because there are so many components to consider, it is costly to make a pass through the data, so it is necessary to arrange the calculations to require as few passes as possible.

---

[6] In spite of the fact that the production version of D041 determines safety levels to meet a backorder target instead of an aircraft availability target, it still carries out the computation in two passes through the component data. Our test version of D041, which uses an aircraft availability target, also requires two passes.

Fortunately, the aggregated derivatives can be calculated in the same two passes as the safety levels. The way this is done is as follows. The first pass is used to find the optimal Lagrange multiplier, u(k,y), just as before. In the second pass, the following coefficients are aggregated (see Eqs. (27a-d) and Eqs. (32a-d)):

$$(35a)\quad \left\{ \begin{array}{l} \text{CBD1(k,y) = Sum(PRICE(i) * CB1(i,y) | all i)} \\ \text{CBD2(k,y) = Sum(PRICE(i) * CB2(i,y) | all i)} \\ \text{CBD3(k,y) = Sum(PRICE(i) * CB3(i,y) | all i)} \end{array} \right.$$

$$(35b)\quad \left\{ \begin{array}{l} \text{CWD1(k,y) = Sum(PRICE(i) * CW1(i,y) | all i)} \\ \text{CWD2(k,y) = Sum(PRICE(i) * CW2(i,y) | all i)} \\ \text{CWD3(k,y) = Sum(PRICE(i) * CW3(i,y) | all i)} \end{array} \right.$$

$$(36)\quad \left\{ \begin{array}{l} \text{CD4(k,y) = Sum(CB4(i,y) + CW4(i,y) | all i)} \\ \text{CD5(k,y) = Sum(CB5(i,y) + CW5(i,y) | all i)} \\ \text{CD6(k,y) = Sum(CB6(i,y) + CW6(i,y) | all i)} \end{array} \right.$$

The coefficients defined in Eqs. (35a), (35b), and (36) can all be calculated in a single pass through the component data, and once calculated they are all that is needed to compute the aggregated derivatives of the safety levels. If we compare Eqs. (34b) with (28e), we see that the latter can be rewritten as:

$$(37)\quad CD4(k,y) * \frac{[u(k,y) * TPROB(k)]'}{u(k,y) * TPROB(k)}$$

$$+ CD5(k,y) * \frac{OIMPG'(k,y)}{OIMPG(k,y)}$$

$$+ CD6(k,y) * TFMCS'(k) = \frac{TPROB'(k)}{TPROB(k)}$$

Similarly, Eqs. (34a) and (35a) can be combined to form:

$$(38a)\quad BSSRD'(k,y) = CBD1(k,y) * \frac{[u(k,y) * TPROB(k)]'}{u(k,y) * TPROB(k)}$$

$$+ CBD2(k,y) * \frac{OIMPG'(k,y)}{OIMPG(k,y)}$$

$$+ CBD3(k,y) * TFMCS'(k)$$

And Eqs. (34b) and (35b) together form:

$$\text{(38b)}\quad WSSRD'(k,y) = CWD1(k,y) * \frac{[u(k,y) * TPROB(k)]'}{u(k,y) * TPROB(k)}$$

$$+ CWD2(k,y) * \frac{OIMPG'(k,y)}{OIMPG(k,y)}$$

$$+ CWD3(k,y) * TFMCS'(k)$$

It is possible to use Eq.(37) to solve for [u(k,y) * TPROB(k)]', and to substitute the result into (38a) and (38b). If this is done, the aggregated derivatives of the safety levels are immediately found to be:

$$\text{(39a)}\quad \frac{d\ BSSRD(k,y)}{d\ OIMPG(k,y)} = \frac{CBD2(k,y) * CD4(k,y) - CBD1(k,y) * CD5(k,y)}{CD4(k,y) * OIMPG(k,y)}$$

$$\text{(39b)}\quad \frac{d\ WSSRD(k,y)}{d\ OIMPG(k,y)} = \frac{CWD2(k,y) * CD4(k,y) - CWD1(k,y) * CD5(k,y)}{CD4(k,y) * OIMPG(k,y)}$$

$$\text{(40a)}\quad \frac{d\ BSSRD(k,y)}{d\ TFMCS(k)} = \frac{CBD3(k,y) * CD4(k,y) - CBD1(k,y) * CD6(k,y)}{CD4(k,y)}$$

$$\text{(40b)}\quad \frac{d\ WSSRD(k,y)}{d\ TFMCS(k)} = \frac{CWD3(k,y) * CD4(k,y) - CWD1(k,y) * CD6(k,y)}{CD4(k,y)}$$

$$\text{(41a)}\quad \frac{d\ BSSRD(k,y)}{d\ TPROB(k)} = \frac{CBD1(k,y)}{CD4(k,y) * TPROB(k)}$$

$$\text{(41b)} \qquad \frac{d\ \mathrm{WSSRD}(k,y)}{d\ \mathrm{TPROB}(k)} = \frac{\mathrm{CWD1}(k,y)}{\mathrm{CD4}(k,y) * \mathrm{TPROB}(k)}$$

We have developed the derivatives (39a) through (41b) for safety levels aggregated over all components applied to a given end item. However, similar expressions can easily be developed for other groups of components, such as all components with procurement lead times between two and three years, or all radar components. It is only necessary to revise Eqs. (35a) and (35b) so that the sums include only components in the desired group. The coefficients defined by Eqs. (36) need not be changed. From that point, the derivation proceeds as given above.

4.6. PREPOSITIONED WAR RESERVE MATERIEL

4.6.1. Kinds of PWRM Authorizations

PWRM is intended to support an engaged unit from the start of its engagement until it can be resupplied by the wholesale echelon. In the Air Force, there are two types of engaged units, those that deploy away from their peacetime location to fight somewhere else, and those that fight from the same location they call home in peacetime. Deploying units require more PWRM than units that fight in place because most of the component repair equipment can only be deployed several weeks after the unit itself deploys. By contrast, all of the repair equipment of the in-place unit is available from the first day of the engagement. The stock authorized for PWRM for a deploying unit is called WRSK (War Reserves Spares Kit), and the PWRM stock authorized for an in-place unit is called BLSS (Base Level Spares Support).

Not all WRSK and BLSS authorizations for a weapon system should be the same. The basic unit in the Air Force is the squadron, but several squadrons can combine to form a wing. If an entire wing deploys to a location, D029 will provide it with less than a full WRSK authorization per squadron. Also, a squadron may deploy to a location already hosting an in-place unit. The deploying squadron can share the repair equipment of the in-place unit, and hence may be given somewhat less than a full WRSK. But in our test version of D041, we neglect these possibilities; for each weapon system we will compute only two kinds of PWRM authorizations, a one-squadron WRSK and a one-squadron BLSS.

In the Navy, PWRM is associated not with a squadron but with an aircraft carrier. When a carrier goes to sea, in peacetime or wartime, it takes with it an inventory of spare parts called an AVCAL. Nominally, the AVCAL is intended to support flying from the carrier at wartime rates for a 90-day period. But the AVCAL also supports peacetime flying from the carrier, so it corresponds to not only the Air Force's PWRM but the base-related part of Peacetime Operating Stock (POS) as well. Because the carrier always goes to sea with component repair equipment, the AVCAL includes the counterpart of the Air Force's BLSS. Marines also have PWRM, but it is our understanding that they, too, expect to be continuously supported with component repair. Thus, their PWRM is also more comparable to the BLSS than to the WRSK.

In our test version of D041, therefore, we consider two kinds of PWRM authorizations for a single squadron, one corresponding to WRSK and one to BLSS. To compute either one, we must describe the wartime scenario it is intended to support, including the operational part of the scenario (flying hours, attrition) and the support part of the scenario (time resupply occurs, time repair becomes available). And as we must for calculating safety stock, we must specify the aircraft availability that we want the PWRM authorization to assure.

4.6.2. The Wartime Scenario

We have specified a wartime scenario in a very simple manner. The PWRM authorization is intended to support a unit for a support period of TSUP days, during which there is no support from the wholesale echelon. During this period, a squadron initially consisting of A(0) of type k aircraft will fly an average of S sorties per day, and suffer an average attrition of a aircraft per sortie. We will assume that every sortie is L flying hours in length.[7]

---

[7]The scenario actually considered in the Air Force to determine PWRM requirements is somewhat more complex. It will divide the support period into two segments, the initial one being perhaps seven days long, and the second segment 23 days long. Different sortie rates and attrition rates will be specified for each segment, the rates for the initial segment generally being higher.

All the scenario parameters may depend on the type of aircraft that make up the squadron. That is, it must be understood that A(0), TSUP, S, and a, all depend on k, the index of the end item. (Actually, we do not compute PWRM separately for engines; instead, we combine engines with aircraft and compute PWRM for the combination.) The Air Force generally assumes TSUP(k) = 30 days for all aircraft, and the Navy assumes TSUP(k) = 90 days. The other parameters differ from one weapon system to another. We consider the effect of changing all of the scenario parameters independently for every weapon system. Conceptually, all parameters may also differ for the various years of the D041 requirements projection, but we have assumed they do not.

Given these parameters, we first compute the numbers of possessed aircraft and hours flown as a function of time from day 0 through day TSUP(k). We define:

A(k,t) = possessed aircraft at time t

CH(k,t) = cumulated flying hours through time t

Since our scenario takes a rather special form, we may calculate:

$$(42a) \qquad A(k,t) = A(k,0) * \exp(- \frac{a(k)}{100} * S(k) * t)$$

$$(43a) \qquad CH(k,t) = L(k) * A(k,0) * \frac{1 - \exp(- \frac{a(k)}{100} * S(k) * t)}{a(k)}$$

The attrition rate, a(k), must be divided by 100 in the above equations, because we have expressed attrition as percentage of aircraft lost per sortie, not fraction lost. In the event that the attrition rate, a(k), is zero for an aircraft type, as it might be, for example, for a transport, the possessed aircraft and cumulated flying hours take on the following simpler form.

(42b) $A(k,t) = A(k,0)$ (if $a(k) = 0$)

(43b) $CH(k,t) = L(k) * S(k) * A(k,0) * t$ (if $a(k) = 0$)

Now we introduce a parameter describing the availability of base repair. For any item i, we assume that there is an initial period, ending on day R(i), during which there is no possibility to repair the component. Thereafter, until day TSUP(k) (which is when the wholesale echelon begins to provide support), base-level repair is available. For a unit that fights in place and hence has a BLSS authorization in the Air Force (this applies to all combat units in the Navy), repair is available from the start of the scenario, so R(i) = 0. For a unit that deploys and hence has a WRSK authorization (Air Force only), there are two categories of items. Some items are designated RR items (for "remove and replace"). There will be no repair of these items until time TSUP(k), the end of the period during which the unit is supported solely by the WRSK. Other items are designated RRR items (for "remove, repair, and replace"). For these, the Air Force nominally assumes R(i) = 5 days.

We have no data at present on which items the Air Force designates RRR for the WRSK. For each weapon system, we will make our own decisions concerning which items should be RRR, in a manner to be described later. As the Air Force does, we will assume that the value of R(i) is the same for all of these items; but in the prototype ORACLE's database we will consider what effects changes in this value may have.

Clearly, more complex scenarios could be considered. As mentioned earlier, the Air Force specifies higher flying tempos and attrition rates for fighter aircraft during the first seven days of the WMP scenarios than during the remainder of the first month. It may well be desirable to enrich the scenario description with which a real ORACLE database can cope, but we feel that our simple description is adequate to demonstrate the methodology.

4.6.3. The Treatment of Engines

Aircraft engines are treated as separate end items in both the Air Force and the Navy. In some ways this makes a great deal of sense, for engines are very costly items that justify the serial number tracking accorded end items. But engines are also components of aircraft and should be considered simultaneously with all other components when determining stockage policies.

We did not do this for peacetime stocks because it would have forced us to deal with the common item problem. This is because two or more aircraft sometimes use the same engine (e.g., both the F-15 and F-16 use the F100 engine). But for PWRM, the common item issue does not arise because each squadron, which consists of aircraft of a single type, relies during the support period solely on its own PWRM stocks. Thus, even though an item may be common to two weapon systems, it acts like a weapon-system-peculiar item in the PWRM problem.

Accordingly, we have included engine components in the computation of PWRM for the seven aircraft types considered in our prototype, and we have not computed PWRM separately for engines. Instead, when calculating PWRM for an aircraft, we treat each engine part as if it were an aircraft part. We adjust the QPA to take into account the fact that there may be multiple engines per aircraft, and we also adjust the demand rates TOIMDR, OIMDDR, and OIMBRR (see Table 1) to reflect the fact that they were obtained by dividing failures by engine flying hours, not aircraft flying hours. (It happens that the two adjustments precisely cancel out.) It would be possible to adjust for the presence of spare engines by allowing more holes for engine items than for other kinds of items, but we have not done so.

We would prefer to treat engines in the same way as D041 treats them for computing safety stock and as D029 treats them for computing PWRM. At present, D041 treats engines as separate end items for peacetime safety stock and other POS requirements computation, but this may not continue when the aircraft availability objective has been incorporated. D029 computes PWRM for engine components by relating them to the aircraft in which the engines are installed. We have no information on Navy procedures in this regard.

4.6.4. Formulation of the PWRM Problem

We have assumed that the failures per flying hour, the fraction of failures repaired at base, the base condemnation fraction, and the base repair cycle days are all the same as in peacetime. This is not, of course, necessary to make the methodology work but merely because we have no data on wartime parameters.[8]

For simplicity, and to entirely decouple the PWRM computation from the computation of peacetime requirements, we will ignore items in base repair when the war starts. For a squadron that deploys, this is proper, but for a squadron that fights in place, these assets would become available. Thus, for the computation of the BLSS, we will somewhat overestimate requirements.

First, consider the expected number of failures of item i from the start of the scenario (t = 0) to an arbitrary time t. This cumulative number of failures is proportional to cumulative flying hours and can be calculated as:

$$\text{CFAILS}(i,t) = \text{TOIMDR}(i) * \text{QPA}(i,k) * \text{CH}(k,t)$$

where we have chosen the end item k to be the proper one for the squadron under consideration. (The quantity TOIMDR(i) is the total OIM demand rate, from Table 1.) Similarly, we can calculate the expected number of successful repairs by time t to be:

[8]There are many reasons to expect that demand rates and condemnation rates, and possibly repair times as well, will be different in wartime than in peacetime. Battle damage might increase demand rates and condemnation percentages. Some equipment (e.g., Electronic Countermeasures gear, gun barrels) will receive heavier use in wartime and may have higher demand rates. Landings may be harder in wartime, leading to more landing gear failures, but transports will fly longer sorties and hence have fewer landings per flying hour. Transport engines, too, will be cycled fewer times per flying hour, so engine parts may have lower failure rates. We have considered none of these factors in the present work.

$$
CREPS(i,t) = \begin{cases} 0 & \text{if } t \le R(i) + BRCD(i) \\ OIMBRR(i) * (1 - \dfrac{CNDB(i)}{100}) * QPA(i,k) * CH(k,t - BRCD(i)) & \\ & \text{if } t > R(i) + BRCD(i) \end{cases}
$$

The net expected number of items that must be supplied out of PWRM by time t is the difference between these two quantities; the maximum of this difference over all times from 0 to TSUP(k) is the quantity to use in sizing the PWRM requirement for item i.

A safety level is also included in PWRM, although unlike the peacetime safety levels, it is not identified separately. As described above, the expected requirement for item i is:

$$
Emax(i) = Max(CFAILS(i,t) - CREPS(i,t) \mid 0 \le t \le TSUP(k))
$$

These expected values are used in a problem of the same kind as (23), to estimate safety levels. The PWRM safety-level problem is simpler than the peacetime safety-level problem because there are no wholesale safety levels to consider. This formulation of the PWRM safety-level problem will overstate the requirement,[9] because in general all the items will not reach their maximum expected values at the same time. This formulation assumes they do.

It is straightforward to determine for an item at what time in the scenario the expected requirement is a maximum. For an item with no repair (a RR item in the WRSK), the maximum must occur at t = TSUP(k).

For a RRR item in the WRSK, there are two possibilities. First, failed items will accumulate until repair is available and begins to produce repaired items. Thus, one candidate time is t = R(i) + BRCD(i)

---

[9]The PWRM requirement will be overstated, and because this is added to other requirements, the eventual total requirement will also be overstated. The actual D029 overstates the PWRM requirement for a similar reason.

(recall that BRCD, from Table 1, is the base repair cycle days). Second, if a substantial fraction of the items cannot be repaired at the base, failed items may accumulate until the end of the support period, so t = TSUP(k) is another possibility. If an item is ever repaired at base level, it is generally the case that almost all of the items can be repaired there and few must be sent back to the depot. This will tend to rule out the second possibility for RRR WRSK items. Also, the RRR items are selected so that repair will make a difference. Thus, the strong candidate is the first, t = R(i) + BRCD(i). But in our methodology, we check both possibilities.

For an item with repair available from the start of the scenario (an item in the BLSS), there are also two possibilities. In fact, this can be considered a special case of the RRR WRSK item, with R(L) = 0. The two possibilities are t = BRCD(i) and t = TSUP(k).

Given nominal values for the scenario parameters, we can find the the times at which the expected requirement for each item is a maximum and what that maximum is. We must do so separately, of course, for the WRSK and the BLSS. Define:

Tmax(i) = time at which the expected requirement for item i is a maximum

Emax(i) = maximum expected requirement for item i

= CFAILS(i,Tmax(i)) - CREPS(i,Tmax(i))

Vmax(i) = the variance in the maximum requirement for item i at time Tmax(i)

= VTMR * Emax(i)

We have assumed that all items have the same variance-to-mean ratio in wartime as in peacetime. The methodology is in no way made more complicated if this assumption is relaxed, but we have no data to suggest what other assumption would be more reasonable.

The means Emax(i) and variances Vmax(i) for the different items are used in a problem much like Problem (23). It is simpler in that there is no involvement of the wholesale echelon. We define WRES(i) to be the total PWRM stocks for item i, including the mean requirement Emax(i) and

an increment to act as a wartime counterpart to the safety level. This is the unknown quantity that will be determined by the PWRM problem. The optimization proceeds as before. Define:

$$(44) \qquad r(i) = \frac{\text{WRES}(i) - \text{Emax}(i) + A(k,0) * \text{QPA}(i,k) * (1 - \text{TFMCS}(k))}{\text{SQRT}(\text{Vmax}(i))}$$

Then the problem of finding PWRM levels becomes:

$$(45) \qquad \begin{cases} \text{Minimize } \text{Sum}(\text{PRICE}(i) * \text{WRES}(i) \mid \text{all } i) \\ \text{s.t.} \quad \text{Prod}(F(r(i)) \mid \text{all } i) \geq \text{TPROB}(k) \\ \qquad\quad \text{WRES}(i) \geq \text{Emax}(i) \end{cases}$$

where once again, the function F(x) denotes the cumulative Normal distribution with zero mean and unit variance. So this problem, as did the similar problem for determining safety-level requirements, has two additional parameters, a target aircraft availability, TFMCS(k), and a target probability, TPROB(k), with which the target availability must be met. The target availability is not used directly; rather, it is used to determine how many aircraft one permits to be unavailable for reasons of supply shortfalls. Following D029, we have tied the unavailability rate to the initial number of aircraft in the squadron, A(k,0). This means that if four aircraft in an initially 24-aircraft squadron are allowed to be unavailable, the same four aircraft can also be unavailable late in the scenario, when attrition may have reduced the total number of aircraft to 12. It is misleading, therefore, to call TFMCS(k) an availability rate in Problem (45). It is better to focus instead upon the product A(k,0) * (1 - TFMCS(k)), calling it, for example, the allowed NMCS aircraft.

Note also that we demand that the war reserve requirement WRES(i) at least equal the expected value, Emax(i). We do this for the same reason that we demanded that the peacetime safety levels exceed zero. See Appendix B for a full discussion.

Problem (45) is the problem of finding prepositioned war reserve requirements for a single squadron assuming a particular operational and support scenario. For each weapon system, there may be two such problems to solve, one for WRSK and one for BLSS. (For some weapon systems, e.g., the transports, we have assumed that there are only BLSS requirements.) To find total PWRM requirements, the WRSK and BLSS requirements must be multiplied by the number of units having WRSK and BLSS authorizations, respectively, and the two products must be added together. Because the number of units of a weapon system may change from year to year, PWRM must be reestimated for each year of the D041 requirements projection. In principle, one might also wish to vary the scenario parameters and TFMCS(k) and TPROB(k) from year to year, but we have not done so. Finally, each weapon system will have its own PWRM requirement, for which a separate computation must be made.

In the same way as for peacetime safety levels, it is possible to write the "Kuhn-Tucker" conditions that must be satisfied by the optimal PWRM authorizations. For a set of war reserve requirements WRES(i) to be optimal, there must be a value for a (new) parameter u(k), the Lagrange multiplier, such that:

For each component i, if WRES(i) > Emax(i), then:

$$g(r(i)) = \frac{PRICE(i) * SQRT(Vmax(i))}{u(k) * TPROB(k)} \tag{46a}$$

For each component i, if WRES(i) = Emax(i), then:

$$g(r(i)) \le \frac{PRICE(i) * SQRT(Vmax(i))}{u(k) * TPROB(k)} \tag{46b}$$

If u(k) = 0, then:

$$Prod(F(r(i)) \mid all\ i) = TPROB(k) \tag{46c}$$

If u(k) = 0, then

(46d) Prod(F(r(i)) | all i) ≥ TPROB(k)

In our test version of D041, we use a method based on these conditions for computing the prepositioned war reserve requirement. (It is similar to the method used in D029 to calculate the actual requirement.) The method requires two passes through the component data. Initially, several trial values of the Lagrange multiplier, u(k), are selected. On the first pass through the component data, Eq. (46a) is solved for each value of u(k) to determine the corresponding value of WRES(i). If the WRES(i) obtained in this way does not exceed Emax(i), it is set equal to Emax(i); it is a characteristic of the function g(x) that this action ensures that Condition (46b) will hold. Once WRES(i) is determined for component i, we calculate r(i) and the probability f(r(i)) and accumulate the product of probabilities as indicated in Condition (46c).

There results from the first pass, therefore, a table of trial values of u(k) and the corresponding probabilities of achieving the target aircraft availability rate. By interpolating within this table, one finds the value of u(k) for which the probability reaches its desired level. (If for all u(k), no matter how near zero, the probability is too large, then we set n(k) = 0, and Condition (46d) will hold. In this case, for every component i it will be true that WRES(i) = Emax(i).)

The second pass repeats the steps of the first but for only the value of u(k) found in the first pass, for which the probability reaches its desired level.

4.6.5. Derivatives of Prepositioned War Reserve Requirements

We wish to calculate the derivatives of the prepositioned war reserve requirements, WRES(i), with respect to the parameters describing the wartime scenario, R(i), L(k), TSUP(k), S(k), and a(k), and with respect to the wartime target availability rate, TFMCS(k), and the

desired probability of achieving that rate, TPROB(k). These derivatives are calculated in essentially the same way as the derivatives of the peacetime safety levels, by an application of an implicit function theorem [12].

To obtain conditions on the derivatives, we differentiate the Kuhn-Tucker Conditions (46a-c), as we did before. Denoting derivatives with primes as before, we obtain for the left-hand side of Eq. (46a):

$$[g(r(i))]' = \frac{dg(r(i))}{dr(i)} * r'(i)$$

$$\frac{dg(r(i))}{dr(i)} = -g(r(i)) * [r(i) + g(r(i))]$$

$$r'(i) = \frac{WRES'(i) - Emax'(i) - A(k,0) * QPA(i,k) * TFMCS'(k)}{SQRT(Vmax(i))} \tag{47}$$

$$- \frac{1}{2} * r(i) * \frac{Vmax'(i)}{Vmax(i)}$$

From the definition of Vmax(i), we can write that:

$$\frac{Vmax'(i)}{Vmax(i)} = \frac{Emax'(i)}{Emax(i)} \tag{48}$$

The quantity Emax(i) depends on all the scenario parameters, R(i), L(k), TSUP(k), S(k), and a(k). However, we will defer the taking of derivatives of Emax(i) with respect to these quantities.

Next we differentiate the right-hand side of Eq. (46a). We let:

$$\text{RHS} = \frac{\text{PRICE(i) * SQRT(Vmax(i))}}{\text{u(k) * TPROB(k)}}$$

Then:

$$\text{RHS}' = \text{RHS} * \left[\frac{1}{2} * \frac{\text{Vmax}'(\text{i})}{\text{Vmax(i)}} - \frac{[\text{u(k) * TPROB(k)}]'}{\text{u(k) * TPROB(k)}}\right]$$

As before, we go no further at this time in the calculation of [u(k) * TPROB(k)]'.

Now we equate the derivatives of the left and right sides. Recalling that g(r(i)) = RHS, according to Condition (46a), and rearranging terms, we obtain an expression for WRES'(i) in terms of other primed quantities. Define the coefficients:

$$\text{(49a)} \quad \left\{ \begin{aligned} \text{CP1(i)} &= \frac{\text{SQRT(Vmax(i))}}{\text{r(i) + g(r(i))}} \\ \text{CP2(i)} &= \frac{\text{SQRT(Vmax(i))}}{2} * \left[\text{r(i)} - \frac{1}{\text{r(i) + g(r(i))}}\right] + \text{Emax(i)} \\ \text{CP3(i)} &= \text{A(k,0) * QPA(i,k)} \end{aligned} \right.$$

Then the expression for WRES'(i) becomes:

$$\text{(50a)} \quad WRES'(i) = CP1(i) * \frac{[u(k) * TPROB(k)]'}{u(k) * TPROB(k)} + CP2(i) * \frac{Emax'(i)}{Emax(i)} + CP3(i) * TFMCS'(k)$$

Condition (50a) must hold for any component i whose optimal prepositioned war reserve requirement, WRES(i), is strictly larger than Emax(i). If WRES(i) = Emax(i), a different condition defines the derivatives, WRES'(i). Thus, for each component i for which WRES(i) = Emax(i), define the coefficients:

$$\text{(49b)} \quad \begin{cases} CP1(i) = 0 \\ CP2(i) = Emax(i) \\ CP3(i) = 0 \end{cases}$$

Then, regardless of whether WRES(i) equals or exceeds Emax(i), Condition (50a) will hold. But (50a) is not by itself sufficient to calculate WRES'(i), since [u(k) * TPROB(k)]' is not known. To compute the latter quantity, we must differentiate Condition (46c). This yields:

$$\text{(51)} \quad Sum(g(r(i)) * r'(i) \mid all\ i) = \frac{TPROB'(k)}{TPROB(k)}$$

Substituting r'(i) from Eq. (47) into Eq. (51) will yield the needed condition. For each component i for which WRES(i) > Emax(i), define:

$$
(52a)\quad \begin{cases} CP4(i) = \dfrac{g(r(i))}{r(i) + g(r(i))} \\[2ex] CP5(i) = -\dfrac{1}{2} * CP4(i) \\[2ex] CP6(i) = 0 \end{cases}
$$

And for each component i for which WRES(i) = Emax(i), define:

$$
(52b)\quad \begin{cases} CP4(i) = 0 \\[2ex] CP5(i) = -\dfrac{1}{2} * g(r(i)) * r(i) \\[2ex] CP6(i) = -\dfrac{g(r(i)) * A(k,0) * QPA(i,k)}{SQRT(Vmax(i))} \end{cases}
$$

Then Condition (51) becomes:

$$\text{(50c)} \quad \text{Sum(CP4(i) | all i)} * \frac{[\text{u(k)} * \text{TPROB(k)}]'}{\text{u(k)} * \text{TPROB(k)}}$$

$$+ \text{Sum(CP5(i)} * \frac{\text{Emax}'\text{(i)}}{\text{Emax(i)}} \text{ | all i)}$$

$$+ \text{Sum(CP6(i) | all i)} * \text{TFMCS}'\text{(k)} = \frac{\text{TPROB}'\text{(k)}}{\text{TPROB(k)}}$$

Condition (50c) defines [u(k) * TPROB(k)]' in terms of known derivatives and, hence, provides a way of computing [u(k) * TPROB(k)]'. But (50c) holds only if Condition (46c) holds, which is only true if the optimal value of the Lagrange multiplier, u(k), is positive. This will be the case most of the time. But when it is not, that is when u(k) = 0, then the derivative of u(k) multiplied by anything will be zero. That is,

$$\text{(50d)} \qquad [\text{u(k)} * \text{TPROB(k)}]' = 0$$

There will be separate derivatives for the WRSK and BLSS requirements. They will have their own Eqs. (50a), with their own coefficients as defined by Eq. (49a) or Eq. (49b), and their own Eqs. (50c), with its coefficients as defined in Eq. (52a), or (52b). We denote the derivatives of the WRSK requirement per squadron as WRESW'(i), and the coefficients defined in Eqs. (49a), (49b), (52a), and (52b), as CPW1(i) through CPW6(i). Similarly, we denote the derivatives of the BLSS requirement per squadron as WRESB'(i) and the six coefficients as CPB1(i) through CPB6(i).

4.6.6. Derivatives of Emax(i)

The results of the previous subsection offer a way to compute derivatives of WRES(i) with respect to Emax(i), TPROB(i), and TFMCS(i). But we wish to compute derivatives, not with respect to Emax(i), but instead with respect to the scenario parameters R(i), L(k), TSUP(k), S(k), and a(k). To do so, we will need the derivatives of Emax(i) with respect to these quantities, and we will obtain them in this subsection.

Computing the derivative of Emax(i) with respect to each parameter is rather tedious, but the only real complication has to do with the fact that the time Tmax at which the maximum expected requirement Emax for an item occurs may be either R(i) + BRCD(i) or TSUP(k). If a scenario parameter is changed, Tmax may abruptly shift from one of these possibilities to the other. However, we will assume that an item that achieves its maximum expected requirement at R(i) + BRCD(i) (or TSUP(k)) for the nominal scenario will continue to achieve it at R(i) + BRCD(i) (or TSUP(k)) if the scenario is changed. (Note that the time may nonetheless change if the item achieves its maximum at R(i) + BRCD(i) and the parameter R(i) is changed.) *For some items and for changes in* some scenario parameters, this may cause us to understate the PWRM requirement slightly.

Having assumed away the only real difficulty, the rest is mere calculation. There are two cases to consider, one in which Tmax(i) = R(i) + BRLD(i), and one in which Tmax(i) = TSUP(k). If Tmax(i) = R(i) + BRCD(i), then the term CREPS(i,t) is zero, and only CFAILS(i,t) contributes to Emax(i). In writing the derivatives, it will be useful to define the following quantity:

$$\text{FACT1(i)} = \text{TOIMDR(i)} * \text{QPA(i,k)} * \text{L(k)} * \text{A(k,0)}$$

where TOIMDR(i) is the total OIM demand rate from Table 1, L(k) the sortie length, and A(k,0) is the initial aircraft per squadron, as defined above.

The derivatives of Emax(i) will take a somewhat different form, depending on whether the attrition rate, a(k), is zero. Thus:

If Tmax(i) = R(i) + BRCD(i) and a(k) = 0:

$$\text{(53a)} \qquad \frac{d\ Emax(i)}{dS(k)} = FACT1(i) * Tmax(i)$$

$$\text{(53b)} \qquad \frac{d\ Emax(i)}{da(k)} = \frac{-FACT1(i) * [S(k) * Tmax(i)]^2}{200}$$

This derivative has a factor of 100 in the denominator to account for the fact that we have expressed attrition as percentage of aircraft lost per sortie, not fraction lost.

$$\text{(53c)} \qquad \frac{d\ Emax(i)}{dL(k)} = \frac{Emax(i)}{L(k)}$$

$$\text{(53d)} \qquad \frac{d\ Emax(i)}{dR(i)} = \begin{cases} 0 & \text{for BLSS} \\ FACT1(i) * S(k) & \text{if WRSK} \end{cases}$$

$$\text{(53e)} \qquad \frac{d\ Emax(i)}{dTSUP(k)} = 0$$

The derivations of these expressions are straightforward, and we will not include them. A comment on the derivatives with respect to R(i) and TSUP(k), however, is needed. When calculating BLSS requirements, repair is by definition available from the start of the scenario (i.e., R(i) = 0). It therefore makes no sense to vary R(i) in computing BLSS requirements, and we therefore set the derivative to zero. The derivative with respect to TSUP(k) is zero because the maximum requirement does not occur at time TSUP(k), so changing this parameter does not affect Emax(i).

If Tmax(i) = R(i) + BRCD(i) and a(k) > 0

(54a) $$\frac{d\ Emax(i)}{dS(k)} = FACT1(i) * Tmax(i) * \exp(-\frac{a(k)}{100} * S(k) * Tmax(i))$$

(54b) $$\frac{d\ Emax(i)}{da(k)} = \frac{FACT1(i) * S(k) * Tmax(i) * \exp(-\frac{a(k)}{100} * S(k) * Tmax(i))}{a(k)} - \frac{FACT1(i) * (1 - \exp(-\frac{a(k)}{100} * S(k) * Tmax(i))}{a(k)^2} * 100$$

(54c) $$\frac{d\ Emax(i)}{dL(k)} = \frac{Emax(i)}{L(k)}$$

(54d) $$\frac{d\ Emax(i)}{dR(i)} = \begin{cases} 0 & \text{for BLSS} \\ FACT1(i) * S(k) * \exp(-\frac{a(k)}{100} * S(k) * Tmax(i)) & \text{for WRSK} \end{cases}$$

(54e) $$\frac{d\ Emax(i)}{dTSUP(k)} = 0$$

If, on the other hand, Tmax(i) = TSUP(k), we have a different set of derivatives. For these derivatives, we assume that R(i) + BRCD(i) is strictly smaller than TSUP(k), so both CFAILS(i,t) and CREPS(i,t) contribute to Emax(i). We will find it convenient to define the quantity.

$$FACT2(i) = OIMBRR(i) * (1 - \frac{CNDB(i)}{100}) * QPA(i,k) * L(k) * A(k,0)$$

$$Trep(i) = Tmax(i) - BRCD(i)$$

Here, OIMBRR(i) is the OIM base repair rate, CNDB(i) the base condemnation percentage, and BRCD(i) is the base repair cycle in days, from Table 1. (We assume here that TSUP(k) exceeds BRCD(i); otherwise we would take Trep(i) to be zero.) L(k) is sortie length and A(k,0) the initial aircraft per squadron, as defined above.

Again, we will have somewhat different equations, depending on whether the attrition rate, a(k), is zero or positive.

If Tmax(i) = TSUP(k) and a(k) = 0:

(55a) $$\frac{d\ Emax(i)}{dS(k)} = FACT1(i) * Tmax(i) - FACT2(i) * Trep(i)$$

(55b) $$\frac{d\ Emax(i)}{da(k)} = - \frac{FACT1(i) * [S(k) * Tmax(i)]^2}{200} + \frac{FACT2(i) * [S(k) * Trep(i)]^2}{200}$$

(55c) $$\frac{d\ Emax(i)}{dL(k)} = \frac{Emax(i)}{L(k)}$$

(55d) $$\frac{d\ Emax(i)}{dR(i)} = 0$$

$$(55e)\quad \frac{d\ Emax(i)}{dTSUP(k)} = [FACT1(i) - FACT2(i)] * S(k)$$

Here, the derivative with respect to R(i) is zero because the maximum requirement does not occur a repairtime after R(i), so changing R(i) will not affect the requirement. But changing TSUP(k) will affect the requirement, so the derivative with respect to TSUP(k) is no longer zero.

If Tmax(i) = TSUP(k) and a(k) > 0:

$$(56a)\quad \frac{d\ Emax(i)}{dS(k)} = FACT1(i) * Tmax(i) * exp(- \frac{a(k)}{100} * S(k) * Tmax(i))$$

$$- FACT2(i) * Trep(i) * exp(- \frac{a(k)}{100} * S(k) * Trep(i))$$

(56b)
$$\frac{d\,Emax(i)}{da(k)} = \frac{FACT1(i) * S(k) * Tmax(i) * \exp(-\frac{a(k)}{100} * S(k) * Tmax(i))}{a(k)}$$

$$- \frac{FACT1(i) * (1 - \exp(-\frac{a(k)}{100} * S(k) * Tmax(i))}{a(k)^2} * 100$$

$$- \frac{FACT2(i) * S(k) * Trep(i) * \exp(-\frac{a(k)}{100} * S(k) * Trep(i))}{a(k)}$$

$$+ \frac{FACT2(i) * (1 - \exp(-\frac{a(k)}{100} * S(k) * Trep(i))}{a(k)^2} * 100$$

(56c)
$$\frac{d\,Emax(i)}{dL(k)} = \frac{Emax(i)}{L(k)}$$

(56d)
$$\frac{d\,Emax(i)}{dR(i)} = 0$$

(56e)
$$\frac{d\,Emax(i)}{dTSUP(k)} = FACT1(i) * S(k) * \exp(-\frac{a(k)}{100} * S(k) * Tmax(i))$$

$$- FACT2(i) * S(k) * \exp(-\frac{a(k)}{100} * S(k) * Trep(i))$$

In Sec. 4.6.5 above, we obtained an expression (50a) that gave the derivatives of the war reserve requirement in terms of various other derivatives, including Emax'(i). Using the results of the present section, we are able to express Emax'(i) in terms of scenario parameters, thus:

$$\text{(57)} \quad Emax'(i) = \frac{d\ Emax(i)}{dS(k)} * S'(k) + \frac{d\ Emax(i)}{da(k)} * a'(k)$$

$$+ \frac{d\ Emax(i)}{dL(k)} * L'(k) + \frac{d\ Emax(i)}{dR(i)} * R'(i)$$

$$+ \frac{d\ Emax(i)}{dTSUP(k)} * TSUP'(k)$$

4.6.7. Computing Aggregate PWRM Requirements and Their Derivatives

We remind the reader that each aircraft type may have two kinds of PWRM requirements, one corresponding to WRSK and one to BLSS. Each may have its own scenario parameters, and each will be required by a different set of users. We denote by UWR(k,y) the number of WRSK users, and by UBL(k,y) the number of BLSS users, of end item k in year y. If the WRSK problem yields requirements for component i of WRESW(i) and the BLSS problem WRESB(i), then the total requirement for component i is:

$$\text{(58)} \quad PWRM(i,y) = UWR(k,y) * WRESW(i) + UBL(k,y) * WRESB(i)$$

The ORACLE database needs derivatives of PWRM requirements aggregated across all components applied to a given end item. It does not need derivatives for individual components. The aggregation is performed by weighting each component's PWRM requirement or its derivative by the price of the component, and accumulating the result over all components belonging to the same end item. If we let PWRMD(k,y) denote the aggregated PWRM requirement for end item k in year y, then we will have:

(59) PWRMD(k,y) = Sum(PRICE(i) * PWRM(i,y) | all i)

The aggregated derivatives, again denoted by prime, will be:

PWRMD'(k,y) = Sum(PRICE(i) * PWRM'(i,y) | all i)

Or, if we define:

WRESWD'(k) = Sum(PRICE(i) * WRESW'(i) | all i)

WRESBD'(k) = Sum(PRICE(i) * WRESB'(i) | all i)

Then we may write (from Eq. (58)):

(60) PWRMD'(k,y) = UWR(k,y) * WRESWD'(k) + UBL(k,y) * WRESBD'(k)

In this section, we will show how the derivatives WRESWD'(k) (or equivalently WRESBD'(k) can be calculated during the second pass through the item data (recall that the first pass establishes the correct value of the Lagrange multiplier, u(k).

We will substitute from Eqs. (50a) and (57) into the above expression for WRESWD'(k). (The same procedure works for WRESBD'(k).) Recall that when dealing with WRSK requirements, we refer to the coefficients defined in Eqs. (49a), (49c), (52a), and (52c), as CPW1(i) through CPW6(i). The result of the substitution is:

$$\text{(61a)}\quad WRESWD'(k) = Sum(PRICE(i) * CPW1(i) \mid all\ i) * \frac{[u(k) * TPROB(k)]'}{u(k) * TPROB(k)}$$

$$+ Sum(\frac{PRICE(i) * CPW2(i)}{Emax(i)} * \frac{d\ Emax(i)}{dS(k)} \mid all\ i) * S'(k)$$

$$+ Sum(\frac{PRICE(i) * CPW2(i)}{Emax(i)} * \frac{d\ Emax(i)}{da(k)} \mid all\ i) * a'(k)$$

$$+ Sum(\frac{PRICE(i) * CPW2(i)}{Emax(i)} * \frac{d\ Emax(i)}{dL(k)} \mid all\ i) * L'(k)$$

$$+ Sum(\frac{PRICE(i) * CPW2(i)}{Emax(i)} * \frac{d\ Emax(i)}{dR(i)} \mid all\ i) * R'(i)$$

$$+ Sum(\frac{PRICE(i) * CPW2(i)}{Emax(i)} * \frac{d\ Emax(i)}{dTSUP(k)} \mid all\ i) * TSUP'(k)$$

$$+ Sum(PRICE(i) * CPW3(i) \mid all\ i) * TFMCS'(k)$$

We will also substitute Eq. (57) into Eq. (50c). The result is:

$$(61c) \quad \mathrm{Sum}(\mathrm{PRICE}(i) * \mathrm{CPW4}(i) \mid \text{all } i) * \frac{[u(k) * \mathrm{TPROB}(k)]'}{u(k) * \mathrm{TPROB}(k)}$$

$$+ \mathrm{Sum}(\frac{\mathrm{PRICE}(i) * \mathrm{CPW5}(i)}{\mathrm{Emax}(i)} * \frac{d\ \mathrm{Emax}(i)}{dS(k)} \mid \text{all } i) * S'(k)$$

$$+ \mathrm{Sum}(\frac{\mathrm{PRICE}(i) * \mathrm{CPW5}(i)}{\mathrm{Emax}(i)} * \frac{d\ \mathrm{Emax}(i)}{da(k)} \mid \text{all } i) * a'(k)$$

$$+ \mathrm{Sum}(\frac{\mathrm{PRICE}(i) * \mathrm{CPW5}(i)}{\mathrm{Emax}(i)} * \frac{d\ \mathrm{Emax}(i)}{dL(k)} \mid \text{all } i) * L'(k)$$

$$+ \mathrm{Sum}(\frac{\mathrm{PRICE}(i) * \mathrm{CPW5}(i)}{\mathrm{Emax}(i)} * \frac{d\ \mathrm{Emax}(i)}{dR'(i)} \mid \text{all } i) * R'(i)$$

$$+ \mathrm{Sum}(\frac{\mathrm{PRICE}(i) * \mathrm{CPW5}(i)}{\mathrm{Emax}(i)} * \frac{d\ \mathrm{Emax}(i)}{d\mathrm{TSUP}(k)} \mid \text{all } i) * \mathrm{TSUP}'(k)$$

$$+ \mathrm{Sum}(\mathrm{PRICE}(i) * \mathrm{CPW6}(i) \mid \text{all } i) * \mathrm{TFMCS}'(k)$$

$$= \frac{\mathrm{TPROB}'(k)}{\mathrm{TPROB}(k)}$$

To compute the derivatives WRESWD'(k), we accumulate all of the coefficients in Eqs. (61a) and (61c) during one pass through the component data. Recall that there are two passes, one to obtain the

proper value for u(k) and a second to compute the requirements WRESW(i). It is during the second pass that we will accumulate these coefficients. At the end of this pass, therefore, we will have computed all the following quantities used in Eq. (61a):

$$
(62a)\quad \begin{cases}
\text{CPWD1(k)} = \text{Sum(PRICE(i) * CPW1(i) | all i)} \\[2ex]
\text{CPWD2a(k)} = \text{Sum(}\dfrac{\text{PRICE(i) * CPW2(i)}}{\text{Emax(i)}} * \dfrac{\text{d Emax(i)}}{\text{dS(k)}} \text{ | all i)} \\[2ex]
\text{CPWD2b(k)} = \text{Sum(}\dfrac{\text{PRICE(i) * CPW2(i)}}{\text{Emax(i)}} * \dfrac{\text{d Emax(i)}}{\text{da(k)}} \text{ | all i)} \\[2ex]
\text{CPWD2c(k)} = \text{Sum(}\dfrac{\text{PRICE(i) * CPW2(i)}}{\text{Emax(i)}} * \dfrac{\text{d Emax(i)}}{\text{dL(k)}} \text{ | all i)} \\[2ex]
\text{CPWD2d(k)} = \text{Sum(}\dfrac{\text{PRICE(i) * CPW2(i)}}{\text{Emax(i)}} * \dfrac{\text{d Emax(i)}}{\text{dR(i)}} \text{ | all i)} \\[2ex]
\text{CPWD2e(k)} = \text{Sum(}\dfrac{\text{PRICE(i) * CPW2(i)}}{\text{Emax(i)}} * \dfrac{\text{d Emax(i)}}{\text{dTSUP(k)}} \text{ | all i)} \\[2ex]
\text{CPWD3(k)} = \text{Sum(PRICE(i) * CPW3(i) | all i)}
\end{cases}
$$

We will also have obtained the following similar quantities used in Eq. (61c):

$$
(62c)\quad \left\{
\begin{aligned}
CPWD4(k) &= Sum(PRICE(i) * CPW4(i) \mid all\ i) \\
CPWD5a(k) &= Sum(\frac{PRICE(i) * CPW5(i)}{Emax(i)} * \frac{d\ Emax(i)}{dS(k)} \mid all\ i) \\
CPWD5b(k) &= Sum(\frac{PRICE(i) * CPW5(i)}{Emax(i)} * \frac{d\ Emax(i)}{da(k)} \mid all\ i) \\
CPWD5c(k) &= Sum(\frac{PRICE(i) * CPW5(i)}{Emax(i)} * \frac{d\ Emax(i)}{dL(k)} \mid all\ i) \\
CPWD5d(k) &= Sum(\frac{PRICE(i) * CPW5(i)}{Emax(i)} * \frac{d\ Emax(i)}{dR(i)} \mid all\ i) \\
CPWD5e(k) &= Sum(\frac{PRICE(i) * CPW5(i)}{Emax(i)} * \frac{d\ Emax(i)}{dTSUP(k)} \mid all\ i) \\
CPWD6(k) &= Sum(PRICE(i) * CPW6(i) \mid all\ i)
\end{aligned}
\right.
$$

Equation (61c) can be used to determine the value of [u(k) * TPROB(k)]' in terms of the other derivatives, and this can be substituted into Eq. (61a) to yield the desired derivatives of WRESWD(k). The results are:

$$
(63)\quad \frac{d\ WRESWD(k)}{dS(k)} = \frac{CPWD4(k) * CPWD2a(k) - CPWD1(k) * CPWD5a(k)}{CPWD4(k)}
$$

$$(64)\quad \frac{d\ WRESWD(k)}{da(k)} = \frac{CPWD4(k) * CPWD2b(k) - CPWD1(k) * CPWD5b(k)}{CPWD4(k)}$$

$$(65)\quad \frac{d\ WRESWD(k)}{dL(k)} = \frac{CPWD4(k) * CPWD2c(k) - CPWD1(k) * CPWD5c(k)}{CPWD4(k)}$$

$$(66)\quad \frac{d\ WRESWD(k)}{dR(i)} = \frac{CPWD4(k) * CPWD2d(k) - CPWD1(k) * CPWD5d(k)}{CPWD4(k)}$$

$$(67)\quad \frac{d\ WRESWD(k)}{dTSUP(k)} = \frac{CPWD4(k) * CPWD2d(k) - CPWD1(k) * CPWD5d(k)}{CPWD4(k)}$$

$$(68)\quad \frac{d\ WRESWD(k)}{dTFMCS(k)} = \frac{CPWD4(k) * CPWD3(k) - CPWD1(k) * CPWD6(k)}{CPWD4(k)}$$

$$(69)\quad \frac{d\ WRESWD(k)}{dTPROB(k)} = \frac{CPWD1(k)}{CPWD4(k) * TPROB(k)}$$

There will be virtually identical formulas for the corresponding derivatives of WRESBD(k), the aggregated BLSS requirement. Once these have been calculated, they can be substituted into Eq. (60) along with Eqs. (63)-(69) to obtain the derivatives of the total PWRM requirement.

We have developed derivatives of war reserve requirements aggregated over all components applied to the same end item. But similar derivatives can readily be developed for other groups of items. It is only necessary to modify Eqs. (62a) so that the sums include only the items in the desired group. Equations (62c) are not changed. Equations (63)-(69), with the modified coefficients from Eqs. (62a), still accurately express the derivatives.

4.7. OTHER WAR RESERVE MATERIEL

There does not seem to be a generally accepted method for estimating OWRM requirements. Requirements computed by the present method (using a model called LOGRAMS in the Air Force, and buying a fixed number of days' expected wartime demand of shelf stock in the Navy) are not widely accepted as "true" requirements; they remain largely unfunded year after year. We have accordingly chosen not to incorporate the dependence of OWRM on the wartime scenario in our test version of D041. We have not, however, ignored OWRM completely. The extract of the D041 database that we are using contains, for each item, a requirement for OWRM. We have interpreted this number as an additive requirement, i.e., a requirement that must be filled but does not depend on any programmed activity or capability. In our test version of D041, therefore, OWRM is merely a constant.

Although our test version of D041 does not properly consider OWRM, we do have some views on the best way to approach the calculation of this part of the requirement, which we discuss in Sec. 6.2.

4.8. ADDITIVES AND THE TOTAL GROSS REQUIREMENT

In addition to the base stock described in Sec. 4.4, there are negotiated levels, which we denote by NEGSL(i). There are always special cases to consider, such as environmental conditions peculiar to a particular location, or special equipment or activities peculiar to a particular base, that the D041 computation described so far does not consider. These special cases will necessitate some bases having extra stocks of certain items, and these extra stocks are negotiated by the people involved and provided to D041 as additives. In D041, provision is made for the negotiated stock levels to vary over time, but we have assumed them to be constant.

In addition, there is a depot floating stock requirement, which we denote DFLSL(i). We mentioned this in Sec. 4.4., during our discussions of stock required to support programmed depot maintenance of aircraft and engine overhauls. DFLSL(i) is a data element found in the D041 database.

The other additives include such things as requirements to support foreign military sales, high-priority mission support kits, special projects, etc. The bulk of these requirements seems to be for foreign military sales. We denote these requirements by OADD(i). In D041 they are allowed to vary over time, but we have assumed that they are constant.

The last line of Table 2 is the sum of all the separate requirements identified so far, and is called the total Air Force gross requirement for the item, which we denote by TGIR(i,y), and which we calculate as:

$$(70)\quad \begin{aligned} TGIR(i,y) = {} & OIOPR(i,y) + BOSR(i,y) + BRCR(i,y) + DORCR(i,y) \\ & + BSSR(i,y) + WSSR(i,y) + PWRM(i,y) + OWRM(i) \\ & + PNOR(i,y) + PNSR(i,y) + PJOR(i,y) + PJSR(i,y) \\ & + ENOR(i,y) + ENSR(i,y) + EJOR(i,y) + EJSR(i,y) \\ & + NEGSL(i) + DFLSL(i) + OADD(i) \end{aligned}$$

The total gross requirements can be accumulated across items to determine the aggregate dollar value of the gross requirement. In addition, previous sections have discussed how the various terms in Eq. (70) depend on programmed activities and capabilities and how derivatives with respect to these quantities may be obtained. These derivatives, when appropriately aggregated over items, allow one to estimate the dependence of the total dollar value of gross requirements on program information, without carrying out multiple item-by-item computations.

4.9. APPLICATION OF ASSETS

4.9.1. Asset Application for a Single Item

In the previous section, we estimated the total gross requirement for an item. To determine how many of this item must be repaired or bought in a given year, we must compare the gross requirement with the available assets, a process which in D041 is called "asset application."

Table 3 illustrates asset application for the same example item that was featured in Tables 1 and 2.

There are several kinds of assets considered in D041. First are serviceable on-hand assets (the Navy would call them RFI, or "ready for issue", assets). These are the most accessible assets. Second, there are failed components that can be repaired by intermediate maintenance. Recall that the number of items in this category was calculated in Sec. 4.4, Eq. (3). In any year y, the number estimated by Eq. (3) is the number that intermediate-level repair could process over all the years from asset cutoff through year y--i.e., the estimate is cumulated across years rather than being year-specific. This allows components that fail in one year to be easily carried over to the next, in the event that their repair is not necessary in the year they failed.

Next are a number of asset categories that we have combined into depot repairables. Included in this category are failed components due to OIM, PDM, and EOH activities (Sec. 4.4, Eqs. (4), (18), and (19)). Also included is any backlog possessed by the depot as of the asset cutoff date, adjusted to account for potential condemnations.

Finally, there are "due in" and "on order" assets. These may be on order from the contractor or due in from any of several sources. These assets are not available as of the asset cutoff date and hence may not be immediately applied against requirements.

Initially, one applies serviceable stocks on hand against the requirement, as this is the least costly option. We let SVCBL(i) be the quantity of serviceable assets of item i available at asset cutoff. The amount that can be applied against requirements can exceed neither the requirement nor the assets available. Thus, if SVAPL(i,y) denotes the amount that can be applied in year y, we have:

$$\text{(71)} \qquad SVAPL(i,y) = Min(TGIR(i,y),SVCBL(i))$$

We then define two quantities, a "first over position," denoted OVER1(i,y), and a "first short position," denoted SHORT1(i,y). These tell us, respectively, the serviceable assets we were unable to apply, and the requirement that remains after applying all the serviceable assets we can. Clearly, either OVER1(i,y) or SHORT1(i,y) must be zero. The equations are:

(72a) $$OVER1(i,y) = SVCBL(i) - SVAPL(i,y)$$

(72b) $$SHORT1(i,y) = TGIR(i,y) - SVAPL(i,y)$$

If serviceable on-hand assets cannot satisfy the entire requirement, we determine how much of the remaining requirement can be satisfied by intermediate-level repair. We have already calculated PBREP(i,y), the potential repairs at the intermediate level, in Eq. (3) of Sec. 4.4. The number we actually apply against the requirement will be either the shortage remaining after serviceable assets are applied, or the number available to apply, whichever is smaller. That is:

(73) $$ABREP(i,y) = Min(SHORT1(i,y), PBREP(i,y))$$

where ABREP(i,y) denotes actual intermediate-level repairs. Once again, we calculate our net position after this step in asset application. We let OVER2(i,y) be the surplus of potential intermediate-level repairs over actuals, and SHORT2(i,y) be the requirement that remains after intermediate-level repairable assets are applied. Again, only one of these will be nonzero.

(74a) $$OVER2(i,y) = PBREP(i,y) - ABREP(i,y)$$

(74b) $$SHORT2(i,y) = SHORT1(i,y) - ABREP(i,y)$$

At wholesale, this procedure is repeated. To repairable components that arrive from intermediate level are added the repairable components generated during engine overhauls and PDMs at the depot, as well as any backlog of unrepaired components present as of the asset cutoff date. Any requirement not satisfied by serviceable on-hand stocks or repair at the ILM may be satisfied in part by repair of these components, less an allowance for condemnations. The equations describing this step are quite simple. We first calculate the potential depot repairs as:

(75) $$PDREP(i,y) = PODREP(i,y) + PPDREP(i,y) + PEDREP(i,y) + BACKLOG(i) * \left(1 - \frac{CNDDO(i)}{100}\right)$$

The quantity BACKLOG(i) is the number of component i in backlog at the depot on the asset cutoff date. Except for the backlog term, all parts of this expression appear in Eqs. (4), (18), and (19) of Sec. 4.4. The actual depot repairs, denoted by ADREP(i,y), are:

(76) $$ADREP(i,y) = Min(SHORT2(i,y), PDREP(i,y))$$

As before, we determine another over and short position. Because we have combined several of the asset categories used in D041, we cannot calculate the D041 third over and short positions. We can, however, calculate the fourth short position and the sum of the third and fourth over positions (which we nonetheless denote OVER4(i,y)).

(77a) $$OVER4(i,y) = PDREP(i,y) - ADREP(i,y)$$

(77b) $$SHORT4(i,y) = SHORT2(i,y) - ADREP(i,y)$$

In the event that there still remains an unsatisfied requirement, assets that are due in or on order can be applied against it. These assets are not presently in hand and can only be applied against requirements that occur later than the expected date of receipt of the assets. However, the D041 data that we possess do not include the times at which these assets are expected to be received, although the total due in and on order assets is among our data. We therefore apply all due in and on order assets right from asset cutoff. We denote by DUEIN(i) the quantity of item i that is due in or on order, and we estimate the number we can apply to be:

(78) $$DIAPL(i,y) = Min(SHORT4(i,y), DUEIN(i))$$

Again, we compute over and short positions. In D041, the due in assets are distinguished from the on order assets, so fifth and sixth short and over positions are calculated. But we have combined these asset categories, so we compute only the sixth short position and the sum of the fifth and sixth over positions (which we nonetheless call OVER6(i,y)):

(79a) OVER6(i,y) = DUEIN(i) - DIAPL(i,y)

(79b) SHORT6(i,y) = SHORT4(i,y) - DIAPL(i,y)

Finally, if all requirements are still not satisfied, the remainder must be purchased. That is, SHORT6(i,y) is D041's estimate of the number of item i that must be bought by the end of year y. However, what D041 has estimated is the number of components that must be received from the contractor by the date in question. The items must be placed on contract a procurement leadtime earlier than they must be received. Similarly, ADREP(i,y) is D041's estimate of the number of item i that must be repaired at the depot by the end of year y.

Note that D041 computes requirements to buy or repair an item by the end of a particular year--i.e., a requirement that is cumulated from the asset cutoff date to the end of each year of the requirements projection. This is quite different from a requirement to buy or repair the item during a certain year. It is easiest to understand if the requirement is steadily increasing, for then one may have to buy, say, six items by the end of year 1, ten items by the end of year 2, and 13 items by the end of year 3. One way to accomplish this is to buy six items in the first year, four in the second, and three in the third, but one might also buy all 13 in the first year. It is harder to grasp the implications of the cumulative nature of the D041 computation in the case that requirements do not steadily increase. For example, if we extend the sequence of buy requirements to be 12 items by the end of year 4, and nine by the end of year 5, this means that if we meet the third-year requirement of 13, we must expect to have a surplus of items

in later years; or to put it another way, if we only buy three items per year, we will fall short of the requirement in years 1-3, but meet it in year 4 and exceed it in year 5.

But why might requirements decline? The requirement for a component in any year consists of the operating requirement cumulated through the end of the year plus the "level" requirements. Like any cumulation of things, the cumulated operating requirement cannot decline from one year to the next. But the level requirement consists of components needed to fill pipelines, WRM stockpiles, etc. And these can decline if the component is used less actively as time goes on. Perhaps the weapon system to which it applies is being phased out of the force or a new item is taking its place. Whatever the reason, we can anticipate that if we meet the requirement during the peak years, we will be left in a surplus position in later years. If the peak is sufficiently short-lived, we may wish to deliberately plan to suffer a shortage during those years, in order to better spend the money elsewhere.

4.9.2. Aggregate Buy and Repair Requirements

Both the buy and repair requirements are produced in two forms: They are presented to each item manager for the individual items he manages; and they are produced in an aggregate form (the CSIS), which by DoD instruction is a required input into the PPBS. The CSIS aggregates across items to determine the total dollars needed to buy and repair components cumulated through each year of the D041 projection. The items are aggregated by weapon system and even partitioned between dollars spent for POS, PWRM, and OWRM--although the rules for this partitioning can be severely criticized. This process, called "stratification," occurs in both the Air Force as part of the D041 computation and in the Navy as a separate computation called "the STRAT." But both the Air Force CSIS and the Navy STRAT fail to afford the programmer in the PPB system a means to estimate the effects of program changes on buy or repair dollar requirements.

The ORACLE database offers a way to overcome this shortcoming. In previous sections, we have calculated how various parts of the gross requirement for a component depend on programmed activities and

capabilities. In this section, we describe how the results of these earlier sections can be used to estimate the sensitivity of the net buy and repair requirements to the same program changes.

The method we use is the same for any programmed quantity, so in this section we will always identify the quantity being varied by Q. This could represent a peacetime OIM, PDM, or EOH program in any year for any end item, or a target peacetime FMCS rate, or a wartime scenario parameter. It is first necessary to determine, for each component, how the item gross requirement, potential intermediate-level repairs, and potential depot-level repairs depend on the quantity Q. This we have accomplished in earlier sections, by our calculation of derivatives. Second, we reason our way step by step through the asset application process to determine for the item whether and by how much a small change in Q will affect the assets applied at each step. Finally, we aggregate over items, thus obtaining the derivative of the dollar value of assets applied at each step with respect to the quantity Q.

Now define the following derivatives with respect to Q, using the same "prime" notation introduced earlier.

T'(i,y) = derivative of item i gross requirement cumulated through year y, TGIR(i,y)

B'(i,y) = derivative of potential intermediate-level repairs of item i cumulated through year y, PBREP(i,y)

D'(i,y) = derivative of potential depot repairs of item i cumulated through year y, PDREP(i,y)

These are the derivatives we have calculated in earlier sections. (For most programmed quantities Q, B'(i,y) and D'(i,y) are zero. Only for the OIM programs, OIMPG(i,y) and its cumulated counterpart, is B'(i,y) not zero, and only for the OIM, PDM, and EOH programs and their cumulated counterparts is D'(i,y) not zero.)

We first apply on-hand serviceable assets against the requirement. If we change Q, we will change only the amount of serviceable assets applied if all the serviceable assets are not already being applied,

i.e., if TGIR(i,y) < SVCBL(i), or equivalently, SHORT1(i,y) > 0. Thus, we may write that:

$$\text{(80a)} \qquad \text{SVAPL}'(i,y) = \begin{cases} T'(i,y) & \text{if SHORT1}(i,y) = 0 \\ 0 & \text{if SHORT1}(i,y) > 0 \end{cases}$$

Aggregating, we can estimate the change in total dollar value of applied serviceable assets as:

$$\text{(80b)} \qquad \text{SVAPLD}'(k,y) = \text{Sum}(\text{PRICE}(i) * \text{SVAPL}'(i,y) \mid \text{all } i)$$

To estimate the effect of a change in Q on the dollar value of applied serviceable assets, we multiply the derivative of SVAPLD(y) by the amount of the program change and add this product to the serviceable assets applied under the nominal programs. Clearly, this procedure will lead to substantial errors if the program change is made large enough. If the total requirement becomes large enough, all serviceable assets will be applied, and further increases in Q cannot further increase SVAPLD(y). The procedure just outlined, however, will predict that SVAPLD(y) will continue to increase. Our validation results, given in Sec. 5, indicate that at least for the extract of the D041 database we have used, this procedure gives quite good agreement with an exact item-by-item computation for a wide range of program variations.

Next we consider the change in actual intermediate-level repairs. There are three possibilities. First, if SHORT1(i,y) is zero, the whole requirement was satisfied from serviceable assets, and it is very likely that some were left over. Small changes in Q may increase total requirements, but the increase will (except in a few cases) be satisfied from serviceable assets not applied in the nominal case. Thus, if SHORT1(i,y) is zero, a change in Q will not affect intermediate-level repairs.

Second, if SHORT1(i,y) is positive but SHORT2(i,y) is zero, then any increase in SHORT1(i,y) will be accommodated by repairing additional items at the intermediate level. It will not matter that the potential number of intermediate-level repairs may also rise, since there is already a surplus in this quantity.

Finally, if SHORT2(i,y) is positive, all potential repairs are being done at the intermediate level. Any increase in Q will result in an increase in intermediate-level repair only to the extent that it increases potential repairs, PBREP(i,y). Thus, the expression for the derivative of actual intermediate-level repairs with respect to Q is:

$$\text{(81a)} \quad \text{ABREP}'(i,y) = \begin{cases} 0 & \text{if SHORT1}(i,y) = 0 \\ T'(i,y) & \text{if SHORT1}(i,y) > 0 \\ & \text{and SHORT2}(i,y) = 0 \\ B'(i,y) & \text{if SHORT2}(i,y) > 0 \end{cases}$$

Then the dependence on Q of the total value of items actually repaired at the intermediate level is:

$$\text{(81b)} \quad \text{ABREPD}'(k,y) = \text{Sum}(\text{PRICE}(i) * \text{ABREP}'(i,y) \mid \text{all } i)$$

The equations for depot repairs are almost identical to those for repairs at intermediate level. We have:

$$\text{(82a)} \quad \text{ADREP}'(i,y) = \begin{cases} 0 & \text{if SHORT2}(i,y) = 0 \\ T'(i,y) - B'(i,y) & \text{if SHORT2}(i,y) > 0 \\ & \text{and SHORT4}(i,y) = 0 \\ D'(i,y) & \text{and SHORT4}(i,y) > 0 \end{cases}$$

The reason for subtracting B'(i,y) when SHORT2(i,y) is positive and SHORT4(i,y) is zero is that increases in potential intermediate-level repairs will satisfy some of the increase in the requirement, and we must not allow depot-level repairs to increase more than enough to satisfy the remaining part of the increase. The dependence on Q of the total value of items actually repaired at the depot is:

(82b) ADREPD'(k,y) = Sum(PRICE(i) * ADREP'(i,y) | all i)

We are also interested in computing the cost of repairing items at the depot and not merely in the value of the items repaired. This quantity is easily estimated, along with its dependence on Q, as:

(83) DPEM(k,y) = Sum(REPCST(i) * ADREP(i,y) | all i)

(84) DPEM'(k,y) = Sum(REPCST(i) * ADREP'(i,y) | all i)

Due in and on order assets are dealt with in essentially the same way. For any item i we may calculate the dependence of applied due in assets on Q as:

$$\text{(85a)} \quad \text{DIAPL}'(i,y) = \begin{cases} 0 & \text{if SHORT4}(i,y) = 0 \\ T'(i,y) - B'(i,y) - D'(i,y) & \text{if SHORT4}(i,y) > 0 \\ & \text{and SHORT6}(i,y) = 0 \\ 0 & \text{if SHORT6}(i,y) > 0 \end{cases}$$

Again, the application of due in assets cannot exceed the increase in the requirement, less whatever part of that increase is satisfied by depot- and intermediate-level repairs. The dependence on Q of the total value of due in items applied is:

(85b) DIAPLD'(k,y) = Sum(PRICE(i) * DIAPL'(i,y) | all i)

The sixth short position represents the items that must be bought, but funds to buy these items must be obligated in prior years to allow for the production lead time. We separate items into three groups, accordingly as the total lead time (administrative (ALT(i)) plus production (PLT(i))) is less than one year, between one year and two years, or between two and three years. The D041 database will not accommodate lead times in excess of three years. The lead times are measured in months, so letting TLT(i) = ALT(i) + PLT(i) be the total lead time in months, we define:

(86a) BUY1(k,y) = Sum(PRICE(i) * SHORT6(i,y) | $0 \leq$ TLT(i) < 12)

(86b) BUY2(k,y) = Sum(PRICE(i) * SHORT6(i,y) | $12 \leq$ TLT(i) < 24)

(86c) BUY3(k,y) = Sum(PRICE(i) * SHORT6(i,y) | $24 \leq$ TLT(i))

To estimate the dependence of these dollar buy requirements on Q, we must first know the derivatives of SHORT6(i,y) with respect to Q for each item. These derivatives can be estimated in the same way as earlier ones. Thus:

$$(87) \quad SHORT6'(i,y) = \begin{cases} 0 & \text{if } SHORT6(i,y) = 0 \\ T'(i,y) - B'(i,y) - D'(i,y) & \text{if } SHORT6(i,y) > 0 \end{cases}$$

The dependence of the three buy quantities on Q is then:

$$(88a) \quad BUY1'(k,y) = Sum(PRICE(i) * SHORT6'(i,y) \mid 0 \le TLT(i) < 12)$$

$$(88b) \quad BUY2'(k,y) = Sum(PRICE(i) * SHORT6'(i,y) \mid 12 \le TLT(i) < 24)$$

$$(88c) \quad BUY3'(k,y) = Sum(PRICE(i) * SHORT6'(i,y) \mid 24 \le TLT(i))$$

In Secs. 4.5 and 4.6, we showed how to calculate derivatives of peacetime safety levels and prepositioned war reserve requirements. In neither case was it possible to complete the calculation of a component's derivatives T'(i,y), until we had passed through the data for all components. Nonetheless, it was possible to calculate derivatives of requirements aggregated over groups of components without making an extra pass through the data.

This must be done to calculate derivatives of net requirements. Looking back to Eqs. (80a-b), the aggregated applied serviceable assets is a sum across the group of components for which SHORT1(i,y) is zero. Similarly, from Eqs. (81a-b), actual base repairs are an aggregation across items for which SHORT1(i,y) is positive and SHORT2(i,y) is zero. And similarly for the other aggregated quantities defined in this section.

5. RESULTS

5.1. EXTRACT FROM THE D041 DATABASE

5.1.1. General Characteristics

The prototype ORACLE database is constructed from an extract of the D041 database as of March 31, 1980. The extract contains 4596 items, characterized as follows:

- Each item is peculiar to one of 12 end items, consisting of seven aircraft and the five engines they use (i.e., there are no common items--but see Appendix A). The aircraft are specified to the mission-design level (in the Navy, type-model level), the seven aircraft being the B-52, C-5, C-135, C-141, F-4, F-15, and F-16. The five engines are the F100, J-57, J-79, TF-33, and TF-39. Table 4 identifies which aircraft use which engines.
- Each item is installed directly on the end item; no item is treated as being indentured to another (again, see Appendix A).
- The items all have "demand-based" requirements. Nearly two-thirds of the items in the D041 database have had such low historical demands that their requirements are entirely established on the principle that "we ought to have one or two just in case." No such items are in our extract. Of course, the effect of these items on the budgets for buying and repairing components must be taken into account, but this will simply be an additive to the numbers estimated using the programmer's database.

5.1.2. Composition of End Items

The extract contains a wide variety of items, as indicated by their Federal Supply Class (FSC). The FSC of an item consists of the first four digits of the stock number and identifies the general kind of item. Table 5 lists the more important FSCs in our extract, and Fig. 3a shows the makeup of the various end items in terms of FSCs. The bars in Fig.

Table 4: End Items Considered in Prototype Programmer's Database

Type End Item	End Item	No. Items	Engines Used No.	Engines Used Type
Aircraft	B052	692	8	J057
			or 8	TF033
	C005	373	4	TF039
	C135	702	4	J057
	C141	453	4	TF033
	F004	985	2	J079
	F015	265	2	F100
	F016	331	1	F100
Engine	F100	330		
	J057	99		
	J079	76		
	TF033	206		
	TF039	84		
	Total	4596		

3a are striped at 10 percent intervals, where the percentages use as a base the purchase price of all items applied to an end item. Every FSC that contributed at least 10 percent to even one end item is included.

Figure 3a indicates that for all of the aircraft we consider, a large fraction of the value of items on the aircraft is concentrated in aircraft structural components (FSC 1560). But the aircraft are quite different otherwise. Only the B-52 has aircraft bombing fire control components (FSC 1280), and the B-52 and F-4 are the only aircraft with high values of electronic countermeasure components (FSC 5865). The C-5 stands out for its landing gear components (FSC 1620), and the C-135 for its radio and television communications equipment (FSC 5821), which are used by the EC-135 configurations. The F-15 has an expensive radar (FSC 5841), and the F-16 is loaded with gunnery fire control equipment (FSC 1270).

Table 5: Federal Stock Classes Heavily Represented in the Extract

FSC	No. Items	Description
1270	258	Aircraft Gunnery Fire Control Components
1280	75	Aircraft Bombing Fire Control Components
1430	118	Guided Missile Remote Control Systems
1560	831	Aircraft Structural Components
1620	92	Aircraft Landing Gear Components
1630	46	Aircraft Wheel and Brake Systems
1650	170	Aircraft Hydraulic, Vacuum and De-Icing System Components
1660	143	Aircraft Air Conditioning, Heating and Pressurizing Components
1680	204	Miscellaneous Aircraft Accessories and Components
2835	17	Gas Turbines and Jet Engines, except Aircraft and Components
2840	570	Gas Turbine and Jet Engines, Aircraft and Components
2915	195	Engine Fuel System Components, Aircraft
2935	17	Engine Cooling System Components, Aircraft
2995	63	Miscellaneous Engine Accessories, Aircraft
4320	43	Power and Hand Pumps
5815	6	Teletype and Facsimile Equipment
5821	222	Radio and Television Communication Equipment, Airborne
5826	131	Radio Navigation Equipment, Airborne
5841	77	Radar Equipment, Airborne
5865	266	Electronic Countermeasure Equipment
5895	89	Miscellaneous Communications Equipment, Airborne
5985	17	Antennas, Waveguides, and Related Equipment
6110	31	Electrical Control Equipment
6605	53	Navigational Instruments
6610	104	Flight Instruments
6615	96	Automatic Pilot Mechanisms and Airborne Gyro Components
6720	11	Cameras, Still Picture
6760	34	Photographic Equipment and Accessories
7021	26	Automatic Data Processing Central Unit (CPU, Computer, Digital)
Other	591	
Total	4596	

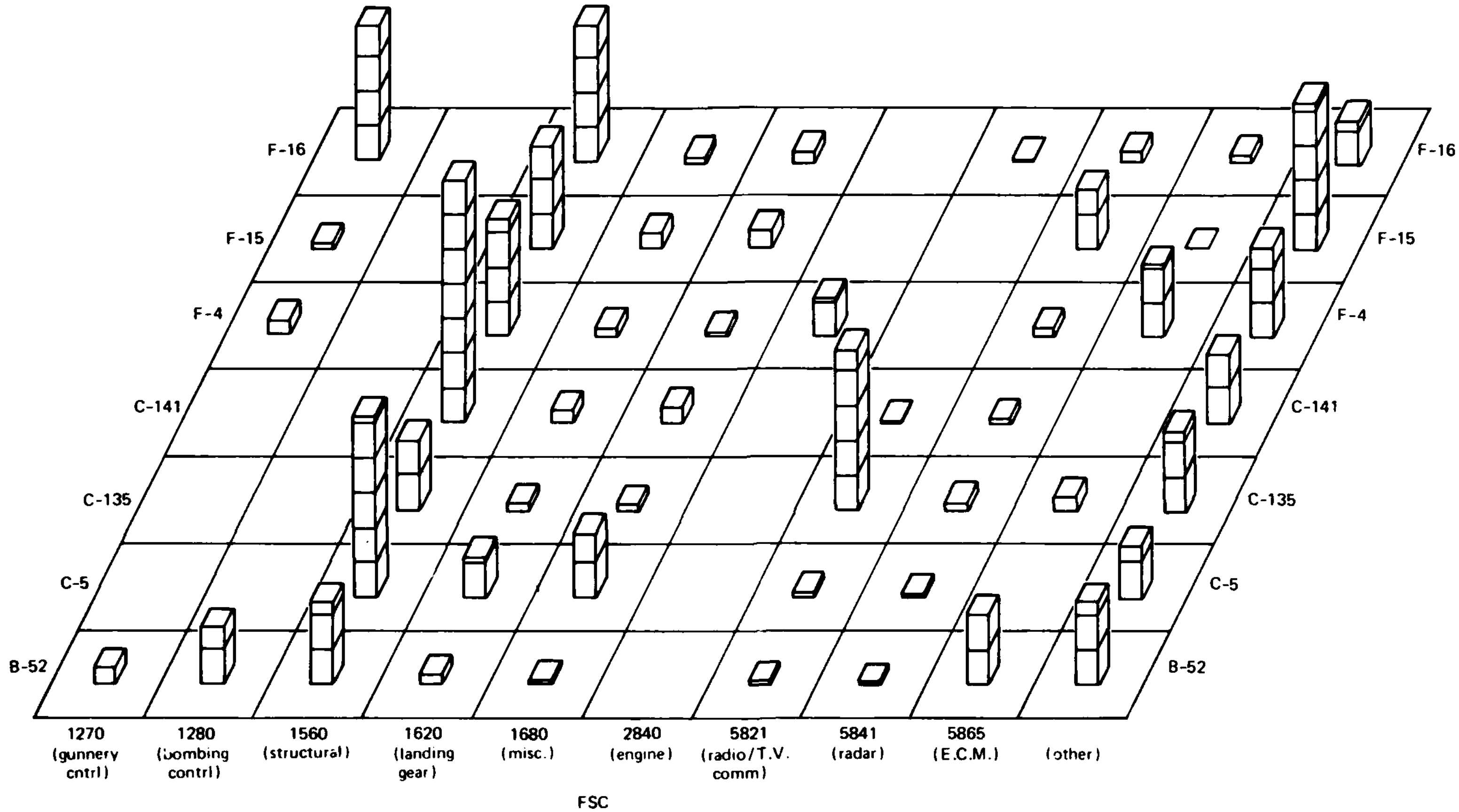


Fig. 3a – Makeup of aircraft in terms of component types

There are various anomalies in the data. For example, the F-15 and F-16 actually have a good deal of electronic countermeasures gear (FSC 5865) that does not appear in our extract. Perhaps these items had such low demands that they were designated insurance, contingency, or NSO (numerical stockage objective) items; such items do not have demand-based requirements and are not in our extract. Another anomaly is that engine components (FSC 2840) appear as F-4 items. We have no explanation for this.

Turning to Fig. 3b, we see the much simpler picture for engines. Engines are mostly made of engine components (FSC 2840) but with a significant contribution of fuel system components (FSC 2915).

5.1.3. Key Factors

We now look at some characteristics of the items, as defined by the key factors used in the D041 computation (see Table 1). We discuss each factor in Table 1 in its order of appearance.

The total OIM demand rate, TOIMDR, ranges from zero to 0.03 failures per flying hour, with a mean of 0.0007. On the average, the depot OIM demand rate, OIMDDR, and the base OIM repair rate, OIMBRR, are each about half of TOIMDR; but this average across items is misleading. It is far more common (although not invariable) to find that an item is either nearly always repaired at base (OIMBRR nearly equal to TOIMDR) or nearly always sent to the depot (OIMDDR nearly equal to TOIMDR), than to find individual items with OIMBRR and OIMDDR nearly equal. Of the 4024 items in the extract that have a nonzero total OIM demand, 20 percent of the items are repaired at base on 80 percent or more of the occasions they fail, and another 50 percent of the items are repaired at base on less than 20 percent of the occasions they fail.

Looking next at the base condemnation percentage, CNDB, we note that of 4596 items, 4285 have base condemnation percentages of zero, and 4455 have percentages of 10 percent or less. Clearly, the base rarely condemns items.

The distributions of pipeline times makes it obvious that most times are not historically observed times but rather standards. For example, of the 4596 items in the extract, 2069 of them have an order-

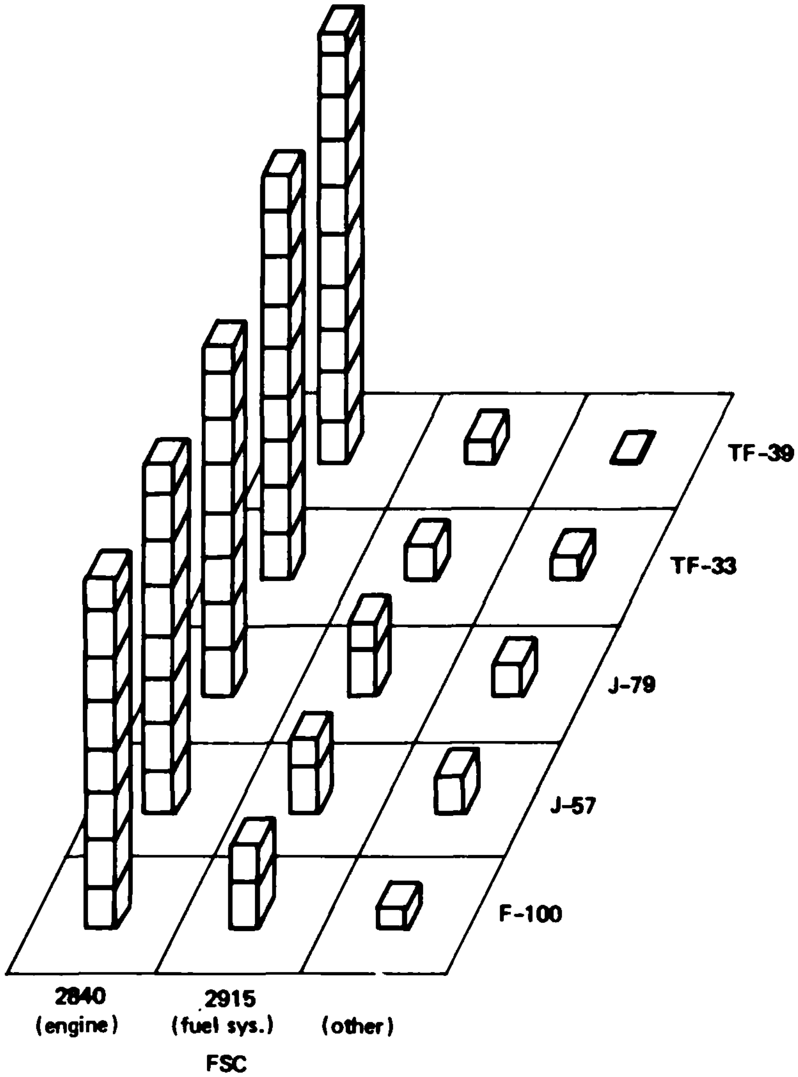


Fig. 3b — Makeup of engines in terms of component types

and-ship time, BOSTD, of 14 days, which is identified as a standard in the D041 training manual. The remainder almost all have times between six and 15 days, although a few have times exceeding 60 days.

The base repair cycle times, BRCD, are most frequently six days (1595 occurrences) for items that are repaired at intermediate level. For items that are repaired only at the depot, or which have no OIM demand at all, a favorite entry for the base repair cycle time is zero; of course, in these cases this factor has no effect. Even when the base

repair cycle time is not six days, it is usually between two and eight days, although it can occasionally exceed 30 days.

D041 distinguishes several segments of the total depot repair cycle time, TDRCD. The first segment is the base processing time, which is typically two days (1026 occurrences) for items not repaired at the base, and six days--or whatever the base repair time is--for items that are repaired at the base. Next is the retrograde transportation time. For over 300 items, including 149 that have a positive OIM depot demand rate, the retrograde time is zero, which suggests that values were simply never entered. But the most frequently encountered time is 15 days (1706 occurrences), and most times are between ten and 20 days.

Third is the supply-to-maintenance time, for which the most prevalent value is ten days. We have been given the following explanation for this number. Once a failed component arrives at the depot, it must be logged into the supply computer, which takes (nominally) one day. The supply computer must inform the maintenance computer that the item is available. The two computers talk to each other only once every two weeks, which causes an average delay of seven days. Finally, it takes a day for maintenance to discover that their computer knows about the item, and yet another day to physically transfer the item from supply to maintenance. Thus, the standard supply-to-maintenance time is ten days. Not all items have a ten-day supply-to-maintenance time. Another 1196 items have a time of zero, which in one sense seems more reasonable (since it is short), and in another less reasonable (since it is perhaps too short).

The fourth segment of the depot repair cycle is the shop flow days. Thirty days is the most popular number, with 1293 occurrences, but 60 days (161 occurrences) and 90 days (126 occurrences) stand out as well. There is even one item with a shop flow time of 270 days. At the other extreme, there are close to 2000 items with shop flow times of ten days or less.

The fifth and final segment is the serviceable turn-in time. This is two days for 3331 items, and 15 days for another 791 items. Most of the remaining items have times of zero or one days.

The total depot repair cycle time, TDRCD, is the sum of these five segments. There is no single time that is overwhelmingly more prevalent than all the others, which indicates that most items have an observed rather than a standard time for at least one segment. Over 40 percent of the items have times between 30 and 45 days, and 10 percent have times exceeding 75 days. The largest contributors to the total depot repair cycle time are the retrograde transportation time and the shop flow time.

Next in Table 1 come factors relating to DLM activities, PDM and EOH. Section 4.3 describes the three factors that D041 contains to help estimate the demands that arose from each DLM program. Table 1 shows these three factors as REPNP, RPLNP, and CNDJP for the PDM program, and as REPNE, RPLNE, and CNDJE for the EOH program.

For the PDM program, we look only at the 3801 items applied to aircraft, since Air Force policy dictates that during PDM there should be no more work done on the engines than would be done by an intermediate-level facility--i.e., no depot-level maintenance on the engine. Of these 3801 items, 2107 have a nonjob-routed repair percentage (REPNP) of zero, and another 1399 a percentage of 100. Only 295 items have intermediate repair percentages. We have been told that it is standard practice to perform the repair job routed if the repair facility is located at the same depot as that performing the PDM, and otherwise to perform the repair nonjob routed. For example, the F-4 has most PDMs done at the Ogden ALC, where the facility to repair landing gear is located; so F-4 landing gears that PDM determines need repairs are repaired job routed. But the C-5 has its PDM performed elsewhere, so its PDM-derived landing gear repairs are all done nonjob routed.

The PDM nonjob-routed replacement percentage (RPLNP) is zero for 2414 of the 3801 aircraft items, and 100 percent for 101 items. Clearly, most items never need work during PDM, and some items are replaced as a matter of policy every time the aircraft undergoes its PDM (the counterpart of the points and plugs in the family car). For the remaining items, the replacement percentage is very likely to be low; only 352 items have replacement percentages between 11 and 99, and 173 items between 21 and 99 percent.

PDM job-routed condemnations are rare. Of the 3801 aircraft items in our extract, 3730 have a job-routed condemnation percentage of zero. Of course, this includes the 1399 items whose repair is never job routed.

The EOH factors are very similar to the PDM factors. In our extract, only 795 items are applied to engines, and in our comments on EOH factors we consider only them. Of these 795 items, 426 have a nonjob-routed repair percentage (REPNE) of zero, and 176 have a repair percentage of 100. This leaves 193 items with intermediate values. The nonjob-routed replacement percentage (RPLNE) is zero for 437 items and 100 for 300 items. (The 437 items that are never replaced must include the 176 items that are never repaired nonjob routed.) The job-routed condemnation percentage is 5 or less for 634 items but is 100 for 53 items.

Now consider items repaired at the depot that originated from OIM, or nonjob routed from PDM or EOH. The condemnation percentage for these items, called the depot overhaul condemnation percentage, CNDDO, is generally small, 2866 of the 4596 items having zero condemnations and a total of 3925 items having condemnation rates of 10 percent or less.

The nonjob-routed and job-routed stock-level days, NJRSLD and JRSLD, are virtually always either zero or 14 days. As one would expect, there is a strong tendency for the nonjob-routed stock-level days to be nonzero for items that are repaired nonjob routed at least some of the time, but there are exceptions; 47 aircraft items and 61 engine items have zero nonjob-routed stock-level days and 100 percent nonjob-routed repair percentages. Similarly, there are 500 aircraft items and 14 engine items that have zero job-routed stock-level days but have nonjob-routed repair percentagess of zero (i.e., are always repaired job routed).

Finally, we look at lead times. The administrative lead times, ALT, for both engine and aircraft items seem to be distributed in about the same way, with a peak frequency at three months (2132 items), and 4153 items between two and six months. The production lead time, PLT, is both longer and more variable and differs according to the end item to which the item is applied. Most items (2876) require from nine to 18

months to produce, with an average of about 13.5 months. By end item, however, a different picture emerges. The average production lead times for F100 engine items is over 22 months; for TF-33 engine items, 19 months; and for TF-39 engine items, 17.5 months. For all other end items the averages are between ten and 15 months.

5.1.4. Selection of RRR Components for WRSK Kits

In Tables 6a-6m, we provide information on which we based our selection of items to be RRR in the WRSK of each aircraft. Recall that some WRSK items are stocked in quantities sufficient to support a squadron during the support period without any of the items being repaired, whereas other items are stocked assuming repair capability will arrive early in the support period. The former items are designated RR items and the latter RRR items.

We estimate the value of intermediate repair for a WRSK item as follows. We reason that, for every hour flown by an end item k we will observe TOIMDR(i) * QPA(i,k) failures of item i, which we will have to replace from stock if the item is RR. But if the item is RRR, we can repair OIMBRR(i) * (1 - CNDB(i) * QPA(i,k) of the items, thus reducing our need for stock by this amount. If we multiply this latter quantity by the price of the item, PRICE(i), we obtain the dollar savings per flying hour of making the item RRR.[1]

It is often the case that the equipment required to repair an item will also serve to repair most other items of the same FSC. Thus, instead of selecting individual items to be RRR, we have selected entire FSCs. To determine the value of making all the items of a particular

[1]There will be costs of making an item RRR, of course, costs that we have not considered. An item's repair equipment may be delicate, difficult to transport and set up. The equipment itself requires maintenance and spare parts. Moreover, the capacity of a single repair unit may be greater than required for one squadron, and providing each squadron with its own unit may be very expensive. However, if the value of making the item RRR is great enough, perhaps a way may be found to provide some repair to a deployed squadron during the support period, without insisting that each squadron have its own private repair facility. Because we have not considered the costs of making a component RRR we cannot show that our choice of items to be RRR is a reasonable one. But our purpose here is to demonstrate the ORACLE methodology and not to select RRR items, so this omission is not important for our purpose.

FSC RRR items, we simply sum the values for the individual items. These are the values found in Tables 6a-6m.

Finally, the data in the D041 database include an estimate of the prepositioned war reserve requirement made by D029. Not all items have a PWRM requirement. In the prototype programmer's database we have computed PWRM requirements only for items that D041 already tells us have such a requirement. Thus, only these items can be RRR WRSK items.

Tables 6a-6m are arranged as follows. Each row refers to a different FSC, the FSC being identified in the first column. Next there are two pairs of columns, the first in each pair giving the number of items of that FSC, and the second giving the value of items repaired per flying hour (PRICE(i) * OIMBRR(i) * (1 - CNDB(i)) * QPA(i,k)). The first pair of columns gives this information for all items, and the second only for items that have a PWRM requirement in the D041 database. For comparison, we include two additional pairs of columns. The first column in each pair is again the number of items of the corresponding FSC, while the second column is the value of items that fail per flying hour (PRICE(i) * TOIMDR(i) * QPA(i,k)). The first of these additional pairs of columns gives information for all items, and the second only for items that the D041 database identifies as having a PWRM requirement.

Tables 6a-6e present information for the five engines we have included among our end items. Engines themselves have no WRSKs, but engine components are found in the WRSKs of aircraft that use the engine. There are some FSCs for some engines that have a large cost in terms of failures per flying hour, but local repair does not appear to have a substantial payoff. Very few engine components are repaired locally; most are sent to the depot. The largest payoff occurs for FSC 2840 items on the TF-39 engine (over $80 per flying hour). But the TF-39 powers the C-5 aircraft, which flies from established bases even in wartime, and has little need to operate without supporting repair facilities. For engines on fighter aircraft (the J-79 and F100 engines), there appear to be no significant savings to be achieved by providing intermediate-level repair for engine components to deploying squadrons.

Table 6a: Identification of RRR WRSK Items for End Item F100

	< SAVINGS FROM LOCAL REPAIR >				< COST WITH NO LOCAL REPAIR >			
FSC	NO. OBS	VALUE ALL OBS	NO. PWRM	VALUE PWRM OBS	NO. OBS	VALUE ALL OBS	NO. PWRM	VALUE PWRM OBS
2840	224	8.66933	8	0.40901	224	84.65306	8	9.22781
2915	12	0.68532	6	.	12	447.81498	6	425.11080
2935	1	0.06647	1	0.06647	1	0.42098	1	0.42098
2995	4	0.77334	1	0.47667	4	5.35788	1	4.34396
OTHER	89	0.15710	7	0.07532	89	40.98580	7	38.26266

Table 6b: Identification of RRR WRSK Items for End Item J057

2840	65	12.69214	.	.	65	90.98979	.	.
2915	14	4.77461	1	0.29355	14	55.28625	1	4.85902
2935	2	0.27535	.	.	2	3.65641	.	.
2995	8	0.30608	1	0.03461	8	6.04657	1	1.17338
4320	5	0.53129	.	.	5	2.97425	.	.
OTHER	5	0.00257	1	0.00257	5	0.17987	1	0.01049

Table 6c: Identification of RRR WRSK Items for End Item J079

2840	33	27.33979	3	3.19830	33	153.65332	3	21.07192
2915	15	2.81496	8	2.32697	15	36.53837	8	31.93410
2935	1	0.00380	.	.	1	0.03990	.	.
2995	7	0.06171	2	0.02847	7	1.62979	2	0.75590
4320	9	0.42008	3	0.38614	9	3.84637	3	2.83240
OTHER	11	0.10109	2	0.04788	11	0.79210	2	0.44584

Table 6d: Identification of RRR WRSK Items for End Item TF033

2840	146	58.31486	52	4.10543	146	192.66663	52	38.12160
2915	19	8.90762	5	2.63252	19	26.60269	5	13.30231
2935	4	0.07045	1	0.02831	4	0.45610	1	0.16985
2995	10	1.30146	7	1.16321	10	4.55776	7	4.10167
4320	6	0.07196	2	0.07056	6	0.79820	2	0.75896
OTHER	21	4.80984	12	0.37396	21	8.03329	12	2.10162

Table 6e: Identification of RRR WRSK Items for End Item TF039

2840	54	85.57231	34	82.91695	54	430.49496	34	413.72444
2915	7	5.64431	6	5.64431	7	62.80334	6	62.79793
2935	1	0.00158	1	0.00158	1	0.02763	1	0.02763
2995	2	0.05438	1	0.02554	2	0.78026	1	0.43418
OTHER	20	0.66892	12	0.66752	20	14.59190	12	14.57602

Table 6f: Identification of RRR WRSK Items for End Item B052

	< SAVINGS FROM LOCAL REPAIR >				< COST WITH NO LOCAL REPAIR >			
FSC	NO. OBS	VALUE ALL OBS	NO. PWRM	VALUE PWRM OBS	NO. OBS	VALUE ALL OBS	NO. PWRM	VALUE PWRM OBS
1270	35	1668.67386	16	241.56276	35	2093.69071	16	412.71176
* 1280	72	5157.21531	28	2467.40036	72	6153.38486	28	2998.23584
1560	147	1488.10469	4	208.54379	147	1778.56322	4	317.09718
1620	10	0.15430	5		10	13.12201	5	11.80128
1630	11	70.94735	9	70.94591	11	109.58322	9	109.55154
1650	28	7.49155	8	4.64623	28	50.41445	8	42.02162
1660	32	2.68588	10	1.23183	32	53.15370	10	21.60510
1680	33	0.96926	9	0.21147	33	6.94653	9	3.23111
2915	33	2.15918	13	1.28025	33	31.86379	13	21.31643
2935	1	0.03931	1	0.03931	1	2.21659	1	2.21659
2995	1	7.60878	1	7.60878	1	152.72555	1	152.72555
4320	10	4.24853	7	4.10517	10	82.14874	7	80.57243
5821	11	268.84671	6	268.29992	11	303.62937	6	302.68394
5826	4	0.04637	1	0.01288	4	0.06866	1	0.01472
5841	10	54.08299	8	54.08299	10	63.62660	8	63.62660
* 5865	77	3097.55853	34	2199.45417	77	3870.40668	34	2893.24942
5895	2	1.90804	.		2	3.09958	.	
5985	3	9.13833	2	9.05990	3	14.35415	2	14.20900
6110	12	4.49492	7	2.36465	12	18.51441	7	14.29888
6605	13	6.29765	3	0.14955	13	2156.47083	3	1.01440
6610	10	2.53347	4	1.76809	10	55.59143	4	32.17834
6615	29	131.56058	22	96.93070	29	260.64450	22	190.83165
6720	2	3.01813	.	.	2	3.11196	.	.
6760	8	14.93928	3	12.94042	8	18.10821	3	15.95994
OTHER	98	25.09341	40	20.10436	98	154.07475	40	113.91333

Table 6g: Identification of RRR WRSK Items for End Item C005

* 1560	88	1765.06174	41	1761.17421	88	2131.46600	41	2119.99330
1620	25	6.46219	5	1.41723	25	18.39754	5	3.21743
1630	5	5.20727	3	4.92906	5	9.29552	3	8.30672
1650	25	6.29360	10	5.95809	25	26.85224	10	26.27295
1660	22	24.95219	20	24.15923	22	52.41531	20	51.47815
1680	65	189.37272	29	138.46375	65	308.05454	29	226.63735
2915	10	5.05502	4	5.03764	10	7.39409	4	7.34569
2995	1	0.13008	1	0.13008	1	2.63412	1	2.63412
4320	1	0.95538	1	0.95538	1	6.82764	1	6.82764
* 5821	5	485.06500	5	485.06500	5	487.30282	5	487.30282
* 5826	39	360.64254	3	317.48048	39	472.47507	3	389.80810
5841	5	33.42556	1	.	5	41.52919	1	2.35576
5895	3	.	.	.	3	0.04221	.	.
5985	1	.	.	.	1	.	.	.
6610	2	0.81519	1	0.81519	2	1.43658	1	1.40767
6615	3	0.40203	2	0.05711	3	1.37595	2	0.33256
OTHER	74	120.74050	23	27.56104	74	246.43353	23	115.66532

Table 6h: Identification of RRR WRSK Items for End Item C135

	< SAVINGS FROM LOCAL REPAIR >				< COST WITH NO LOCAL REPAIR >			
FSC	NO. OBS	VALUE ALL OBS	NO. PWRM	VALUE PWRM OBS	NO. OBS	VALUE ALL OBS	NO. PWRM	VALUE PWRM OBS
1560	147	950.20348	18	84.47717	147	1079.45800	18	132.52000
1620	16	1.02462	2	0.49379	16	12.94738	2	2.01041
1630	9	70.19568	7	70.18387	9	96.79240	7	96.68779
1650	36	25.40490	15	19.79157	36	168.68044	15	116.38536
1660	12	0.33572	9	0.33402	12	6.42129	9	6.36720
1680	18	17.17672	6	15.43570	18	29.79811	6	24.63726
2915	18	1.89003	13	1.86581	18	22.78258	13	22.52880
2935	2	0.27388	1	0.00691	2	0.67700	1	0.14083
2995	7	5.90738	7	5.90738	7	28.93122	7	28.93122
4320	3	1.03462	2	0.62851	3	8.82337	2	7.87807
5815	6	118.16693	1	95.01558	6	151.86601	1	115.83841
* 5821	161	1752.27096	52	1559.39578	161	1906.44144	52	1672.15766
5826	43	108.02581	30	45.56587	43	198.44696	30	122.19834
* 5841	17	353.14568	14	291.85742	17	417.14272	14	349.03378
* 5865	28	526.96551	5	389.91450	28	630.60183	5	432.50540
5895	48	18.84632	11	15.64357	48	19.49442	11	16.05718
5985	9	74.63279	5	73.68249	9	115.21580	5	114.25300
6110	12	4.35001	5	1.27520	12	175.92039	5	172.57523
6605	7	41.33198	1	0.00988	7	84.10919	1	0.13999
6610	7	0.34523	5	0.34292	7	4.51380	5	4.47448
6615	13	24.19151	11	24.16206	13	56.91032	11	56.43729
6680	15	2.30393	13	2.30393	15	33.38243	13	33.37126
6760	1	0.28937	.	.	1	0.53607	.	.
7021	1	2.15000	.	.	1	2.15000	.	.
OTHER	66	41.95014	35	21.43675	66	137.92295	35	110.76732

Table 6i: Identification of RRR WRSK Items for End Item C141

1560	178	188.64198	77	128.25942	178	369.93649	77	240.77232
1620	16	0.63202	5	0.47901	16	3.36532	5	2.48663
1630	7	32.87651	6	25.74849	7	44.11715	6	33.31576
1650	25	13.14648	22	13.05281	25	54.48448	22	54.36847
1660	23	6.06009	21	5.99562	23	21.63900	21	21.51884
1680	33	58.83805	20	39.78631	33	106.52163	20	69.76745
2835	7	6.77991	6	6.77505	7	19.12854	6	19.07018
2915	9	0.50456	8	0.50456	9	1.60090	8	1.60022
2935	2	0.52804	2	0.52804	2	2.19329	2	2.19329
2995	5	0.71109	5	0.71109	5	8.34825	5	8.34825
4320	2	1.10321	2	1.10321	2	5.59534	2	5.59534
5821	23	17.89022	7	17.64511	23	19.17895	7	18.88461
5826	8	7.77780	.	.	8	8.32643	.	.
5841	8	158.01145	6	139.58347	8	184.98654	6	161.08471
6110	1	0.01445	.	.	1	0.01445	.	.
6605	6	2.20722	6	2.20722	6	5.75771	6	5.75771
6610	24	116.71675	19	108.90753	24	192.68594	19	175.51022
* 6615	16	591.75945	10	589.43411	16	697.08463	10	693.37258
OTHER	60	61.99908	40	24.00103	60	103.60323	40	64.67098

Table 6j: Identification of RRR WRSK Items for End Item F004

		< SAVINGS FROM LOCAL REPAIR >				< COST WITH NO LOCAL REPAIR >			
	FSC	NO. OBS	VALUE ALL OBS	NO. PWRM	VALUE PWRM OBS	NO. OBS	VALUE ALL OBS	NO. PWRM	VALUE PWRM OBS
*	1270	143	285.75060	31	279.54271	143	641.30142	31	616.29254
	1280	3	6.43954	2	6.33108	3	11.68077	2	11.07625
*	1430	118	1376.06401	51	1254.75137	118	1641.68317	51	1454.90756
	1560	145	78.62946	8	14.14406	145	212.05980	8	25.77782
	1620	4	3.92493	3	3.71272	4	54.28383	3	53.75130
	1630	5	4.48342	5	4.48342	5	8.94970	5	8.94970
	1650	28	34.14297	7	32.05592	28	122.31946	7	118.04151
	1660	20	3.50729	11	2.95634	20	30.57630	11	24.95816
	1680	11	1.36890	3	0.89841	11	8.86300	3	5.31652
	2840	48	16.57208	2	3.36056	48	129.95008	2	14.62827
	2915	29	5.92701	5	3.86373	29	67.74173	5	41.85417
	2935	2	0.00033	.	.	2	0.08898	.	.
	2995	3	6.58617	1	6.34953	3	40.83530	1	37.41771
	4320	3	0.60733	1	0.13019	3	6.54766	1	0.72466
	5821	15	3.69784	1	0.07199	15	5.07855	1	0.07424
	5826	23	118.06354	12	33.03788	23	167.59271	12	62.93528
*	5841	20	1361.55435	7	1331.79691	20	1475.12848	7	1439.43079
*	5865	146	2550.91269	125	2549.92788	146	4578.67467	125	4535.62337
*	5895	30	320.94319	13	320.94319	30	340.75190	13	340.75190
	5985	2	12.79371	2	12.79371	2	19.87948	2	19.87948
	6110	3	1.97838	2	1.92802	3	7.16130	2	6.12892
*	6605	4	240.66238	4	240.66238	4	341.37289	4	341.37289
*	6610	33	431.07575	21	429.39286	33	575.92379	21	565.89458
	6615	17	168.70371	14	168.69032	17	248.46758	14	247.80796
*	6720	9	293.19990	6	283.92800	9	326.29877	6	313.43409
*	6760	25	311.90112	17	292.98281	25	405.79177	17	383.04258
*	7021	23	348.12563	13	347.03692	23	418.90191	13	417.58504
	OTHER	73	81.57100	37	76.52580	73	147.90704	37	139.21956

Table 6k: Identification of RRR WRSK Items for End Item F015

	< SAVINGS FROM LOCAL REPAIR >				< COST WITH NO LOCAL REPAIR >			
FSC	NO. OBS	VALUE ALL OBS	NO. PWRM	VALUE PWRM OBS	NO. OBS	VALUE ALL OBS	NO. PWRM	VALUE PWRM OBS
1270	1	138.66510	1	138.66510	1	198.09300	1	198.09300
* 1560	46	230.81043	16	218.06013	46	320.96782	16	263.00928
1620	11	32.45473	2	25.17282	11	59.51503	2	37.11731
1630	5	186.04096	5	186.04096	5	204.64789	5	204.64789
1650	21	11.64280	12	6.84594	21	64.10677	12	54.39880
1660	21	5.08542	9	3.67048	21	46.76203	9	33.64788
1680	28	33.60293	11	31.07142	28	44.33023	11	40.49114
2835	3	84.76185	3	84.76185	3	169.81321	3	169.81321
2915	25	5.74948	8	5.30537	25	20.10314	8	17.54881
2995	15	0.45791	3	0.25132	15	0.56913	3	0.36069
4320	1	.	1	.	1	0.35020	1	0.35020
5821	1	0.00692	.	.	1	0.02012	.	.
5826	12	93.04065	10	93.04065	12	126.70498	10	126.70498
* 5841	7	2916.30410	4	1861.61857	7	3547.41209	4	2133.35187
5865	2	3.73844	1	3.70391	2	5.00156	1	4.57799
5895	6	145.25347	6	145.25347	6	194.43199	6	194.43199
6110	1	0.40491	1	0.40491	1	0.42582	1	0.42582
* 6605	2	524.12704	1	504.75706	2	932.10468	1	901.35856
6610	12	72.62584	10	72.62584	12	137.92539	10	137.89584
6615	7	59.37973	6	59.19966	7	116.74599	6	115.95366
7021	2	124.73836	1	93.33651	2	150.81001	1	113.84620
OTHER	36	34.10433	13	30.58045	36	78.54810	13	60.58445

Table 6m: Identification of RRR WRSK Items for End Item F016

* 1270	79	1785.16148	8	1784.90759	79	6544.57782	8	5894.48832
1560	80	41.67465	12	19.30788	80	454.49377	12	37.31292
1620	10	13.58460	3	4.18467	10	22.48448	3	8.57419
1630	4	99.05037	4	99.05037	4	110.23020	4	110.23020
1650	7	10.64663	2	1.38559	7	18.25479	2	3.73006
1660	13	14.25706	8	13.48600	13	34.88836	8	32.57199
1680	16	13.49334	3	2.39807	16	83.17547	3	5.12058
2835	1	.	1	.	1	102.68901	1	102.68901
2915	4	0.70249	2	0.58303	4	1.42449	2	1.17940
2935	1	.	1	.	1	0.07253	1	0.07253
4320	3	0.69280	2	0.57736	3	5.44137	2	5.26041
5821	6	3.35226	1	0.61261	6	10.57298	1	0.61261
5826	2	0.11381	.	.	2	0.23287	.	.
* 5841	10	256.41792	3	256.41792	10	340.99095	3	312.50597
5865	13	10.94556	11	10.68796	13	269.58069	11	269.32307
6110	2	6.75536	1	6.75536	2	18.24826	1	18.24826
6605	21	.	.	.	21	72.87413	.	.
6610	16	0.78822	4	0.70742	16	17.36145	4	8.81847
6615	11	.	2	.	11	20.31707	2	13.98532
OTHER	32	9.35735	18	7.88269	32	59.56631	18	36.60205

* We have selected items with these FSCs to be RRR-WRSK items. But only items for which D041 shows a PWRM requirement are selected.

For aircraft, the picture is very different. Generally, the B-52, C-5, C-135, and C-141 (Tables 6f-6i) operate in wartime from established bases that have intermediate-repair capability available. If, however, a squadron of one of these aircraft types had to operate in a more austere fashion, Tables 6f-6i clearly show for which FSCs it is most important to provide repair capability. These are the FSCs whose rows in the tables are marked with asterisks.

The fighter aircraft are the ones that truly need WRSKs. Tables 6j-6m show the FSCs for which it is most important to provide repair. Again, asterisks mark our choice of the items to be RRR.

5.2. NOMINAL PROGRAMMED ACTIVITIES AND CAPABILITIES

To build the prototype ORACLE database, it was necessary to specify nominal programmed activities and capabilities. We have chosen what we think are reasonable values for our programmed quantities, but we make no claim that they are "real" in all instances. But our purpose is to demonstrate a methodology, and we think our programmed quantities are enough like the "real thing" to serve this purpose.

5.2.1. Peacetime Programs for Aircraft

Tables 7a-7g show the peacetime programmed quantities for aircraft. The total number of aircraft, the number of squadrons, and the flying hours were taken from the PA 84-1. The computer-readable version of this database contains nine years of program data, which we extended to ten years by assuming that year 10 would be a duplicate of year 9. For all but the fighter aircraft, we estimated the number of aircraft per squadron by dividing total aircraft by number of squadrons and rounding down to the nearest integer. For the fighter aircraft, we assumed there were 24 aircraft per squadron. For all aircraft, this procedure left a few aircraft unassigned to squadrons and hence available for PDMs or other occupation.

The target peacetime OIM availabilities and probabilities are our own invention, although for the fighter aircraft they are similar to the wartime availabilities demanded by the Air Force in the D029 computation of prepositioned war reserve requirements. Neither the Air Force nor

Table 7a: Peacetime Program Information for End Item B052

Type Information	Initial Value	Fiscal Year <- 1 ->	<- 2 ->	<- 3 ->	<- 4 ->	<- 5 ->	<- 6 ->	<- 7 ->	<- 8 ->	<- 9 ->	<- 10 ->
TOTAL NO. ACFT	319	317	272	272	255	241	241	241	241	241	241
NO. SQUADRONS	21	21	18	18	16	15	15	15	15	15	15
ACFT PER SQUADRON		15	15	15	15	15	15	15	15	15	15
TARGET OIM AVAIL (%)		66	66	66	66	66	66	66	66	66	66
TARGET OIM PROB (%)		50	50	50	50	50	50	50	50	50	50
ANNUAL FLYING HOURS		32482	26815	29387	32580	29894	29219	29219	29219	29219	29219
ANNUAL NO. PDMs		80	74	68	66	64	62	60	60	60	60

Table 7b: Peacetime Program Information for End Item C005

Type Information	Initial Value	Fiscal Year <- 1 ->	<- 2 ->	<- 3 ->	<- 4 ->	<- 5 ->	<- 6 ->	<- 7 ->	<- 8 ->	<- 9 ->	<- 10 ->
TOTAL NO. ACFT	74	74	74	74	78	89	101	120	120	120	120
NO. SQUADRONS	8	8	8	8	10	10	12	14	14	14	14
ACFT PER SQUADRON		9	9	9	9	9	9	9	9	9	9
TARGET OIM AVAIL (%)		66	66	66	66	66	66	66	66	66	66
TARGET OIM PROB (%)		50	50	50	50	50	50	50	50	50	50
ANNUAL FLYING HOURS		13276	13524	15235	15927	19764	22295	26107	25169	25169	25169
ANNUAL NO. PDMs		19	18	19	18	19	18	19	22	30	30

Table 7c: Peacetime Program Information for End Item C135

Type Information	Initial Value	Fiscal Year <- 1 ->	<- 2 ->	<- 3 ->	<- 4 ->	<- 5 ->	<- 6 ->	<- 7 ->	<- 8 ->	<- 9 ->	<- 10 ->
TOTAL NO. ACFT	707	706	704	702	701	701	701	701	701	701	701
NO. SQUADRONS	58	57	57	57	57	57	57	57	57	57	57
ACFT PER SQUADRON		12	12	12	12	12	12	12	12	12	12
TARGET OIM AVAIL (%)		66	66	66	66	66	66	66	66	66	66
TARGET OIM PROB (%)		50	50	50	50	50	50	50	50	50	50
ANNUAL FLYING HOURS		65114	65088	66095	65767	70905	71440	71405	71355	71615	71615
ANNUAL NO. PDMs		176	176	175	175	175	175	175	175	175	175

Table 7d: Peacetime Program Information for End Item C141

Type Information	Initial Value	Fiscal Year <- 1 ->	<- 2 ->	<- 3 ->	<- 4 ->	<- 5 ->	<- 6 ->	<- 7 ->	<- 8 ->	<- 9 ->	<- 10 ->
TOTAL NO. ACFT	254	254	254	254	254	254	254	254	254	254	254
NO. SQUADRONS	26	26	26	26	26	26	26	26	26	26	26
ACFT PER SQUADRON		9	9	9	9	9	9	9	9	9	9
TARGET OIM AVAIL (%)		66	66	66	66	66	66	66	66	66	66
TARGET OIM PROB (%)		50	50	50	50	50	50	50	50	50	50
ANNUAL FLYING HOURS		72438	72821	75848	76372	76885	77035	77035	77035	77035	77035
ANNUAL NO. PDMs		64	64	64	64	64	64	64	64	64	64

Table 7e: Peacetime Program Information for End Item F004

Type Information	Initial Value	Fiscal Year <- 1 ->	<- 2 ->	<- 3 ->	<- 4 ->	<- 5 ->	<- 6 ->	<- 7 ->	<- 8 ->	<- 9 ->	<- 10 ->
TOTAL NO. ACFT	1526	1438	1475	1473	1485	1437	1359	1299	1238	1154	1154
NO. SQUADRONS	53	49	49	48	47	46	46	47	47	47	47
ACFT PER SQUADRON		24	24	24	24	24	24	24	24	24	24
TARGET OIM AVAIL (%)		83	83	83	83	83	83	83	83	83	83
TARGET OIM PROB (%)		50	50	50	50	50	50	50	50	50	50
ANNUAL FLYING HOURS		87879	92614	95834	98117	93107	88642	81392	76886	70677	70677
ANNUAL NO. PDMs		371	364	369	370	365	350	332	317	299	289

Table 7f: Peacetime Program Information for End Item F015

Type Information	Initial Value	Fiscal Year <- 1 ->	<- 2 ->	<- 3 ->	<- 4 ->	<- 5 ->	<- 6 ->	<- 7 ->	<- 8 ->	<- 9 ->	<- 10 ->
TOTAL NO. ACFT	492	555	576	612	629	665	743	815	891	1047	1047
NO. SQUADRONS	17	19	19	21	22	24	26	29	31	37	37
ACFT PER SQUADRON		24	24	24	24	24	24	24	24	24	24
TARGET OIM AVAIL (%)		83	83	83	83	83	83	83	83	83	83
TARGET OIM PROB (%)		50	50	50	50	50	50	50	50	50	50
ANNUAL FLYING HOURS		38913	42023	45638	49217	49171	56770	63890	72000	84720	84720
ANNUAL NO. PDMs		123	123	123	186	147	156	140	222	225	228

Table 7g: Peacetime Program Information for End Item F016

Type Information	Initial Value	Fiscal Year <- 1 ->	<- 2 ->	<- 3 ->	<- 4 ->	<- 5 ->	<- 6 ->	<- 7 ->	<- 8 ->	<- 9 ->	<- 10 ->
TOTAL NO. ACFT	258	407	554	641	732	816	924	1071	1182	1308	1308
NO. SQUADRONS	10	17	23	26	30	33	38	44	48	52	52
ACFT PER SQUADRON		24	24	24	24	24	24	24	24	24	24
TARGET OIM AVAIL (%)		83	83	83	83	83	83	83	83	83	83
TARGET OIM PROB (%)		50	50	50	50	50	50	50	50	50	50
ANNUAL FLYING HOURS		26132	39626	49589	58585	66274	74185	86132	96316	106944	106944
ANNUAL NO. PDMs		64	65	64	214	211	152	155	298	319	299

the Navy presently establish values for these parameters, although the Air Force must begin to do so when the aircraft availability objective has been substituted in D041's safety-level computation for the present fill rate objective.

The number of PDMs was estimated on the basis that the Air Force has recently been scheduling most aircraft into a PDM once every four years. For the B-52, C-135, C-141, and F-4, all of which have declining or stationary inventories, we assumed that one-quarter of the inventory would pass through PDM in each year. For the C-5, F-15, and F-16, all of which have increasing inventories, we assumed that one-quarter of the initial inventory would pass through PDM every year. In addition, we assumed that in the fourth and eighth year, the incremental inventory of year 1 would pass through PDM. In the fifth and ninth year, the incremental inventory of year 2 would do so. And so forth.

5.2.2. Peacetime Programs for Engines

Tables 8a-8e show the peacetime programmed quantities for engines. The number of users of an engine is the sum of the number of squadrons of all aircraft types that use the engine. For example, the F100 engine powers both the F-15 and the F-16, so the number of F-100 users is the sum of the numbers of F-15 and F-16 squadrons. Both the J-57 and TF-33 are used by the B-52, the former for series B-52A through B-52G, and the latter for the B-52H. From the PA 84-1 we estimate that 32.5 percent of the B-52 aircraft are of series H, so we assigned 32.5 percent of the B-52 squadrons to be users of the TF-33, and 67.5 percent to be J-57 users.

The target peacetime OIM availabilities and probabilities for engines are inherited from the targets for the aircraft. We have demanded an 83 percent availability of the F-4, so we also demand an 83 percent availability of the J-79 engine, which is used by the F-4.

The flying hours for engines are also inherited from the aircraft that use them. Thus, the F-16 uses one F100 engine and thus generates one F100 flying hour for each F-16 flying hour. The F-15 has two F100 engines and hence generates two F100 flying hours for each hour flown by an F-15. We noted before that the B-52 uses two different engines,

Table 8a: Peacetime Program Information for End Item F100

Type Information	Initial Value	Fiscal Year 1	2	3	4	5	6	7	8	9	10
NO. USERS	27	36	42	47	52	57	64	73	75	89	89
TARGET OIM AVAIL (%)		83	83	83	83	83	83	83	83	83	83
TARGET OIM PROB (%)		50	50	50	50	50	50	50	50	50	50
ANNUAL FLYING HOURS		103958	123672	140865	157019	164616	187725	213912	240316	276384	276384
ANNUAL NO. EOHs		35	41	47	52	55	63	71	80	92	92

Table 8b: Peacetime Program Information for End Item J057

Type Information	Initial Value	Fiscal Year 1	2	3	4	5	6	7	8	9	10
NO. USERS	71	70	68	68	67	67	66	66	66	66	66
TARGET OIM AVAIL (%)		66	66	66	66	66	66	66	66	66	66
TARGET OIM PROB (%)		50	50	50	50	50	50	50	50	50	50
ANNUAL FLYING HOURS		441416	399352	416148	439900	446740	443480	443340	443140	444180	444180
ANNUAL NO. EOHs		221	200	208	220	223	222	222	222	222	222

Table 8c: Peacetime Program Information for End Item J079

Type Information	Initial Value	Fiscal Year 1	2	3	4	5	6	7	8	9	10
NO. USERS	53	49	49	48	47	46	46	47	47	47	47
TARGET OIM AVAIL (%)		83	83	83	83	83	83	83	83	83	83
TARGET OIM PROB (%)		50	50	50	50	50	50	50	50	50	50
ANNUAL FLYING HOURS		175758	185228	191668	196234	186214	177284	162784	153772	141354	141354
ANNUAL NO. EOHs		176	185	192	196	186	177	163	154	141	141

Table 8d: Peacetime Program Information for End Item TF033

Type Information	Initial Value	<- 1 ->	<- 2 ->	<- 3 ->	<- 4 ->	<- 5 ->	<- 6 ->	<- 7 ->	<- 8 ->	<- 9 ->	<- 10 ->
NO. USERS	262	262	261	261	260	260	260	260	260	260	260
TARGET OIM AVAIL (%)		66	66	66	66	66	66	66	66	66	66
TARGET OIM PROB (%)		50	50	50	50	50	50	50	50	50	50
ANNUAL FLYING HOURS		368648	366804	386720	389296	383572	384172	384172	384172	384172	384172
ANNUAL NO. EOHs		92	92	97	97	96	96	96	96	96	96

Fiscal Year columns 1–10.

Table 8e: Peacetime Program Information for End Item TF039

Type Information	Initial Value	<- 1 ->	<- 2 ->	<- 3 ->	<- 4 ->	<- 5 ->	<- 6 ->	<- 7 ->	<- 8 ->	<- 9 ->	<- 10 ->
NO. USERS	8	8	8	8	10	10	12	14	14	14	14
TARGET OIM AVAIL (%)		66	66	66	66	66	66	66	66	66	66
TARGET OIM PROB (%)		50	50	50	50	50	50	50	50	50	50
ANNUAL FLYING HOURS		53104	54096	60940	63708	79056	89180	104428	100676	100676	100676
ANNUAL NO. EOHs		13	14	15	16	20	22	26	25	25	25

depending on the series. Since the B-52 has eight engines, each B-52 flying hour generates eight engine flying hours, 32.5 percent of them (2.6 hours) being TF-33 hours, and 67.5 percent (5.4 hours) being J-57 hours.

The annual engine overhauls were estimated by dividing the flying hours by a typical interval between overhauls. The intervals varied by engine and were determined by asking people in AFLC what they thought the intervals should be. For the F100, the interval chosen was 3000 hours. For the J-57, it was 2000 hours; for the J-79, 1000 hours; for the TF-33 and TF-39, 4000 hours.

5.2.3. Wartime Programs

Tables 9a-9g show the wartime scenario information we have used to estimate PWRM requirements. There are no wartime tables for engines, as we include the PWRM requirements for engine components among the requirements associated with the aircraft. Thus, there will be requirements for F100 components in both the F-15 and F-16 PWRM requirements.

We have taken the total number of squadrons deployed to equal the total squadrons given in the peacetime tables, Tables 7a-7g. Similarly, the number of aircraft per squadron is the same in peacetime as in wartime. For the B-52, C-5, C-135, and C-141, we have assumed that all squadrons are supported by BLSS authorizations. For the F-4, F-15, and F-16, half the squadrons have BLSS and half WRSK.

We have taken the target availabilities and probabilities for the B-52, C-5, C-135, and C-141 to be the same as those we chose for peacetime. For the F-4, F-15, and F-16, 83 percent availability corresponds to approximately four out of 24 aircraft grounded for lack of parts, which is the target presently used in D029. The 50 percent probability is intended to make our results compare reasonably with the expected value, although the true expected availability will be somewhat lower than the availability achieved 50 percent of the time (the median availability).

Table 9a: Wartime Program Information for End Item B052

Type Information	Initial Value	Fiscal Year <- 1 ->	<- 2 ->	<- 3 ->	<- 4 ->	<- 5 ->	<- 6 ->	<- 7 ->	<- 8 ->	<- 9 ->	<- 10 ->
TOTAL SQDNS DEPLOYED	21	21	18	18	16	15	15	15	15	15	15
NO. SQDNS WITH WRSK	0	0	0	0	0	0	0	0	0	0	0
NO. SQDNS WITH BLSS	21	21	18	18	16	15	15	15	15	15	15
ACFT/DEPLOYED SQDN	15	15	15	15	15	15	15	15	15	15	15
TARGET AVAIL (%)		66	66	66	66	66	66	66	66	66	66
TARGET PROB (%)		50	50	50	50	50	50	50	50	50	50
SORTIES/DAY PER ACFT		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
ATTRITION LOSS/SORTIE (%)		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
SORTIE LENGTH (HRS)		7	7	7	7	7	7	7	7	7	7
ARRIVAL DAY RRR REPAIR		5	5	5	5	5	5	5	5	5	5
ARRIVAL DAY WHSL SUPT		30	30	30	30	30	30	30	30	30	30

Table 9b: Wartime Program Information for End Item C005

Type Information	Initial Value	Fiscal Year <- 1 ->	<- 2 ->	<- 3 ->	<- 4 ->	<- 5 ->	<- 6 ->	<- 7 ->	<- 8 ->	<- 9 ->	<- 10 ->
TOTAL SQDNS DEPLOYED	8	8	8	8	10	10	12	14	14	14	14
NO. SQDNS WITH WRSK	0	0	0	0	0	0	0	0	0	0	0
NO. SQDNS WITH BLSS	8	8	8	8	10	10	12	14	14	14	14
ACFT/DEPLOYED SQDN	9	9	9	9	9	9	9	9	9	9	9
TARGET AVAIL (%)		66	66	66	66	66	66	66	66	66	66
TARGET PROB (%)		50	50	50	50	50	50	50	50	50	50
SORTIES/DAY PER ACFT		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
ATTRITION LOSS/SORTIE (%)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SORTIE LENGTH (HRS)		12	12	12	12	12	12	12	12	12	12
ARRIVAL DAY RRR REPAIR		5	5	5	5	5	5	5	5	5	5
ARRIVAL DAY WHSL SUPT		30	30	30	30	30	30	30	30	30	30

Table 9c: Wartime Program Information for End Item C135

Type Information	Initial Value	Fiscal Year 1	2	3	4	5	6	7	8	9	10
TOTAL SQDNS DEPLOYED	58	57	57	57	57	57	57	57	57	57	57
NO. SQDNS WITH WRSK	0	0	0	0	0	0	0	0	0	0	0
NO. SQDNS WITH BLSS	58	57	57	57	57	57	57	57	57	57	57
ACFT/DEPLOYED SQDN	12	12	12	12	12	12	12	12	12	12	12
TARGET AVAIL (%)		66	66	66	66	66	66	66	66	66	66
TARGET PROB (%)		50	50	50	50	50	50	50	50	50	50
SORTIES/DAY PER ACFT		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
ATTRITION LOSS/SORTIE (%)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SORTIE LENGTH (HRS)		7	7	7	7	7	7	7	7	7	7
ARRIVAL DAY RRR REPAIR		5	5	5	5	5	5	5	5	5	5
ARRIVAL DAY WHSL SUPT		30	30	30	30	30	30	30	30	30	30

Table 9d: Wartime Program Information for End Item C141

Type Information	Initial Value	Fiscal Year 1	2	3	4	5	6	7	8	9	10
TOTAL SQDNS DEPLOYED	26	26	26	26	26	26	26	26	26	26	26
NO. SQDNS WITH WRSK	0	0	0	0	0	0	0	0	0	0	0
NO. SQDNS WITH BLSS	26	26	26	26	26	26	26	26	26	26	26
ACFT/DEPLOYED SQDN	9	9	9	9	9	9	9	9	9	9	9
TARGET AVAIL (%)		66	66	66	66	66	66	66	66	66	66
TARGET PROB (%)		50	50	50	50	50	50	50	50	50	50
SORTIES/DAY PER ACFT		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
ATTRITION LOSS/SORTIE (%)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SORTIE LENGTH (HRS)		12	12	12	12	12	12	12	12	12	12
ARRIVAL DAY RRR REPAIR		5	5	5	5	5	5	5	5	5	5
ARRIVAL DAY WHSL SUPT		30	30	30	30	30	30	30	30	30	30

Table 9e: Wartime Program Information for End Item F004

Type Information	Initial Value	1	2	3	4	5	6	7	8	9	10
		Fiscal Year									
TOTAL SQDNS DEPLOYED	53	49	49	48	47	46	46	47	47	47	47
NO. SQDNS WITH WRSK	26	24	24	24	23	23	23	23	23	23	23
NO. SQDNS WITH BLSS	27	25	25	24	24	23	23	24	24	24	24
ACFT/DEPLOYED SQDN	24	24	24	24	24	24	24	24	24	24	24
TARGET AVAIL (%)		83	83	83	83	83	83	83	83	83	83
TARGET PROB (%)		50	50	50	50	50	50	50	50	50	50
SORTIES/DAY PER ACFT		2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
ATTRITION LOSS/SORTIE (%)		0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
SORTIE LENGTH (HRS)		2	2	2	2	2	2	2	2	2	2
ARRIVAL DAY RRR REPAIR		5	5	5	5	5	5	5	5	5	5
ARRIVAL DAY WHSL SUPT		30	30	30	30	30	30	30	30	30	30

Table 9f: Wartime Program Information for End Item F015

Type Information	Initial Value	1	2	3	4	5	6	7	8	9	10
		Fiscal Year									
TOTAL SQDNS DEPLOYED	17	19	19	21	22	24	26	29	31	37	37
NO. SQDNS WITH WRSK	8	9	9	10	11	12	13	14	15	18	18
NO. SQDNS WITH BLSS	9	10	10	11	11	12	13	15	16	19	19
ACFT/DEPLOYED SQDN	24	24	24	24	24	24	24	24	24	24	24
TARGET AVAIL (%)		83	83	83	83	83	83	83	83	83	83
TARGET PROB (%)		50	50	50	50	50	50	50	50	50	50
SORTIES/DAY PER ACFT		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
ATTRITION LOSS/SORTIE (%)		0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
SORTIE LENGTH (HRS)		2	2	2	2	2	2	2	2	2	2
ARRIVAL DAY RRR REPAIR		5	5	5	5	5	5	5	5	5	5
ARRIVAL DAY WHSL SUPT		30	30	30	30	30	30	30	30	30	30

Table 9g: Wartime Program Information for End Item F016

Type Information	Initial Value	1	2	3	4	5	6	7	8	9	10
		Fiscal Year									
TOTAL SQDNS DEPLOYED	10	17	23	26	30	33	38	44	48	52	52
NO. SQDNS WITH WRSK	5	8	11	13	15	16	19	22	24	26	26
NO. SQDNS WITH BLSS	5	9	12	13	15	17	19	22	24	26	26
ACFT/DEPLOYED SQDN	24	24	24	24	24	24	24	24	24	24	24
TARGET AVAIL (%)		83	83	83	83	83	83	83	83	83	83
TARGET PROB (%)		50	50	50	50	50	50	50	50	50	50
SORTIES/DAY PER ACFT		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
ATTRITION LOSS/SORTIE (%)		0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.707
SORTIE LENGTH (HRS)		2	2	2	2	2	2	2	2	2	2
ARRIVAL DAY RRR REPAIR		5	5	5	5	5	5	5	5	5	5
ARRIVAL DAY WHSL SUPT		30	30	30	30	30	30	30	30	30	30

We chose the scenario information so that it seemed reasonable, based on aircraft characteristics known from unclassified sources. The B-52, C-5, C-135, and C-141 all fly long sorties and hence can fly only one sortie per day. We assume the F-4 flies somewhat more than two sorties per day, and the F-15 and F-16 three sorties per day throughout the support period. The attrition losses per sortie reported in the tables are chosen to allow the average pilot some reasonable probability of surviving the first weeks of war. The sortie lengths are typical for the different types of aircraft.

We have assumed that repair capability for RRR WRSK items arrives at the end of day 5, and that support of all kinds from the wholesale echelon arrives at the end of day 30. These are the standard Air Force assumptions.

5.3. THE PROTOTYPE ORACLE DATABASE

5.3.1 Gross Requirements and Asset Application by End Item

In Sec. 4, we organized the discussion of the requirements estimation methodology around the requirements computation worksheet for a single item (Tables 2 and 3). To determine what the requirements calculation may tell us about weapon systems, the obvious first step is to aggregate the computation worksheets across all items that apply to the same end item. This is one short step beyond the CSIS computation presently performed by D041, for the CSIS reports only the aggregated "bottom line" (i.e., net buy and repair requirements), whereas the aggregation of Tables 2 and 3 show all the steps by which the bottom line is obtained. Tables 10-21 do this for the 12 end items we consider. The entries in the individual item computation worksheets are multiplied by the price of the item and the results summed over all items having application to the same end item. The tables come in triples. First comes a table that builds the total gross requirement for the end item, then a table showing the application of assets, and finally a table showing the time-phased net buy and depot repair requirements.

Table 10a: TOTAL GROSS REQUIREMENTS FOR END ITEM F100 (THOUSANDS DOLLARS)

FISCAL YEAR:	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
OIM OPER RQMT	60215.	131850.	213443.	304382.	399730.	508468.	632373.	771574.	931663.	1091754.
BASE PIPELINE RQMT	2265.	2695.	3070.	3422.	3587.	4091.	4661.	5237.	6023.	6023.
DEPOT PIPELINE RQMT	10880.	12944.	14743.	16434.	17229.	19647.	22388.	25151.	28926.	28926.
BASE SAFETY LEV RQMT	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.
DEPOT SAFETY LEV RQMT	4403.	4830.	5178.	5464.	5577.	5909.	6274.	6638.	7127.	7127.
NEGOTIATED BASE S/L	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL OIM GROSS RQMT	77764.	152318.	236434.	329702.	426125.	538117.	665697.	808600.	973740.	1133829.
PDM OPER RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PDM PIPELINE RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL PDM GROSS RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH OPER RQMT	6679.	14502.	23470.	33393.	43888.	55910.	69458.	84724.	102280.	119835.
EOH PIPELINE RQMT	251.	294.	337.	372.	394.	451.	508.	573.	659.	659.
TOTAL EOH GROSS RQMT	6929.	14796.	23807.	33766.	44282.	56361.	69967.	85297.	102938.	120494.
PREPOS WRM RQMT	91665.	110030.	123787.	136934.	150073.	166035.	187127.	207061.	229748.	244455.
OTHER WRM RQMT	69661.	69661.	69661.	69661.	69661.	69661.	69661.	69661.	69661.	69661.
ADDITIVE RQMTS	13831.	13831.	13831.	13831.	13831.	13831.	13831.	13831.	13831.	13831.
TOTAL AF GROSS RQMT	259850.	360626.	467511.	583894.	703975.	844004.	1006285.	1184450.	1389918.	1582269.

Table 10b: APPLICATION OF ASSETS FOR END ITEM F100 (THOUSANDS OF DOLLARS)

FISCAL YEAR:	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL AF GROSS RQMT	259850.	360626.	467511.	583894.	703975.	844004.	1006285.	1184450.	1389918.	1582269.
ON HAND SVC ASSETS	79288.	79288.	79288.	79288.	79288.	79288.	79288.	79288.	79288.	79288.
SVC ASSETS APPLIED	43173.	47694.	51113.	54033.	56316.	58608.	60317.	62126.	63931.	65237.
FIRST OVER POS	36114.	31593.	28174.	25254.	22972.	20680.	18970.	17162.	15356.	14051.
FIRST SHORT POSITION	216676.	312939.	416403.	529866.	647664.	785402.	945971.	1122327.	1325992.	1517037.
BASE REP GENS	1076.	2356.	3814.	5440.	7144.	9087.	11301.	13789.	16650.	19511.
POT BASE CNDMN	1.	3.	5.	7.	9.	11.	14.	17.	21.	24.
POT BASE REPAIRS	1075.	2353.	3810.	5433.	7135.	9076.	11288.	13772.	16630.	19487.
ACTUAL BASE REPAIRS	989.	2186.	3601.	5157.	6805.	8753.	11044.	13501.	16334.	19312.
SECOND OVER POS	86.	167.	209.	276.	330.	323.	244.	271.	295.	175.
SECOND SHORT POSITION	215688.	310753.	412802.	524709.	640859.	776649.	934928.	1108826.	1309659.	1497725.
OIM DEPOT REP GENS	59139.	129493.	209629.	298942.	392587.	499382.	621071.	757785.	915013.	1072243.
OIM POT CNDMNS	3328.	7287.	11796.	16822.	22091.	28101.	34948.	42641.	51488.	60336.
OIM POT REPAIRS	55811.	122207.	197833.	282131.	370497.	471282.	586124.	715144.	863526.	1011907.
PDM DEPOT REP GENS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PDM POT CNDMNS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PDM POT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH DEPOT REP GENS	6679.	14502.	23470.	33393.	43888.	55910.	69458.	84724.	102280.	119835.
EOH POT CNDMNS	2459.	5340.	8643.	12297.	16161.	20587.	25576.	31198.	37662.	44127.
EOH POT REPAIRS	4219.	9162.	14828.	21097.	27728.	35323.	43882.	53527.	64618.	75709.
INIT DEPOT BACKLOG	52029.	52029.	52029.	52029.	52029.	52029.	52029.	52029.	52029.	52029.
POT CNDMNS OF BKLOG	8868.	8868.	8868.	8868.	8868.	8868.	8868.	8868.	8868.	8868.
POT REPS OF BKLOG	43161.	43161.	43161.	43161.	43161.	43161.	43161.	43161.	43161.	43161.
TOTAL DEPOT REPARABLES	117846.	196025.	285119.	384365.	488508.	607322.	742561.	894537.	1069322.	1244108.
TOTAL POT CNDMNS	14655.	21494.	29306.	37986.	47120.	57556.	69393.	82707.	98019.	113331.
TOTAL POT REPAIRS	103192.	174530.	255822.	346380.	441386.	549765.	673167.	811831.	971305.	1130777.
ACTUAL DEPOT REPAIRS	93117.	163127.	243547.	333705.	428598.	536944.	660657.	799688.	959739.	1119517.
FOURTH OVER POS	10075.	11404.	12276.	12680.	12794.	12826.	12515.	12148.	11570.	11263.
FOURTH SHORT POSITION	122570.	147630.	169260.	191005.	212261.	239704.	274270.	309135.	349915.	378202.
DUE IN/ON ORDER ASSETS	222663.	222663.	222663.	222663.	222663.	222663.	222663.	222663.	222663.	222663.
APPLIED ASSETS	39748.	43185.	47899.	53234.	58926.	65623.	72927.	77679.	82619.	87582.
SIXTH OVER POS	182915.	179478.	174764.	169428.	163736.	157039.	149735.	144983.	140043.	135080.
SIXTH SHORT POSITION	82822.	104445.	121361.	137771.	153335.	174081.	201343.	231460.	267300.	290625.

Table 10c: TIME PHASED NET BUY AND REPAIR REQUIREMENTS FOR END ITEM F100 (THOUSANDS OF DOLLARS)

FISC. YR	<--(1)-->	<-- 0 -->	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
LEADTIME FOR BUY												
0-1 YR			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1-2 YR		9029.	11203.	12906.	14631.	16302.	18504.	21317.	24090.	27372.	29414.	
2-3 YR	73793.	93243.	108455.	123140.	137032.	155578.	180026.	207370.	239928.	261211.		
TOT BUY	73793.	102272.	119658.	136046.	151663.	171880.	198529.	228687.	264018.	288583.	29414.	0.
TOT REP			16936.	29299.	43878.	60424.	77921.	97893.	120514.	145958.	175294.	204540.

Table 11a: TOTAL GROSS REQUIREMENTS FOR END ITEM J057 (THOUSANDS OF DOLLARS)

FISCAL YEAR:	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
OIM OPER RQMT	70243.	133793.	200016.	270019.	341107.	411680.	482228.	552746.	623429.	694112.
BASE PIPELINE RQMT	2344.	2121.	2210.	2336.	2372.	2355.	2354.	2353.	2359.	2359.
DEPOT PIPELINE RQMT	10680.	9662.	10069.	10643.	10809.	10730.	10727.	10722.	10747.	10747.
BASE SAFETY LEV RQMT	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.
DEPOT SAFETY LEV RQMT	3767.	3583.	3658.	3761.	3790.	3776.	3776.	3775.	3779.	3779.
NEGOTIATED BASE S/L	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL OIM GROSS RQMT	87035.	149159.	215952.	286758.	358079.	428541.	499085.	569595.	640313.	710997.
PDM OPER RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PDM PIPELINE RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL PDM GROSS RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH OPER RQMT	31703.	60394.	90232.	121792.	153783.	185629.	217476.	249323.	281169.	313015.
EOH PIPELINE RQMT	910.	823.	856.	905.	918.	914.	914.	914.	914.	914.
TOTAL EOH GROSS RQMT	32613.	61217.	91088.	122698.	154700.	186543.	218390.	250236.	282082.	313929.
PREPOS WRM RQMT	5255.	5089.	4953.	4861.	4725.	4679.	4679.	4679.	4679.	4679.
OTHER WRM RQMT	2313.	2313.	2313.	2313.	2313.	2313.	2313.	2313.	2313.	2313.
ADDITIVE RQMTS	2311.	2311.	2311.	2311.	2311.	2311.	2311.	2311.	2311.	2311.
TOTAL AF GROSS RQMT	129527.	220090.	316615.	418941.	522126.	624385.	726777.	829135.	931701.	1034231.

Table 11b: APPLICATION OF ASSETS FOR END ITEM J057 (THOUSANDS OF DOLLARS)

FISCAL YEAR:	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL AF GROSS RQMT	129527.	220090.	316615.	418941.	522126.	624385.	726777.	829135.	931701.	1034231.
ON HAND SVC ASSETS	7066.	7066.	7066.	7066.	7066.	7066.	7066.	7066.	7066.	7066.
SVC ASSETS APPLIED	6280.	6494.	6545.	6597.	6638.	6675.	6710.	6745.	6780.	6810.
FIRST OVER POS	786.	572.	522.	470.	428.	391.	356.	321.	286.	256.
FIRST SHORT POSITION	123247.	213596.	310071.	412344.	515489.	617710.	720067.	822390.	924921.	1027421.
BASE REP GENS	8202.	15623.	23356.	31530.	39831.	48072.	56310.	64545.	72799.	81052.
POT BASE CNDMN	15.	29.	44.	59.	75.	91.	106.	122.	137.	153.
POT BASE REPAIRS	8187.	15594.	23312.	31471.	39756.	47982.	56204.	64423.	72661.	80900.
ACTUAL BASE REPAIRS	8147.	15554.	23277.	31441.	39732.	47960.	56182.	64399.	72636.	80874.
SECOND OVER POS	40.	40.	34.	29.	24.	21.	23.	24.	25.	26.
SECOND SHORT POSITION	115100.	198042.	286794.	380903.	475757.	569750.	663884.	757991.	852283.	946547.
OIM DEPOT REP GENS	62041.	118170.	176660.	238489.	301276.	363608.	425919.	488202.	550631.	613060.
OIM POT CNDMNS	2073.	3949.	5904.	7970.	10069.	12152.	14234.	16316.	18402.	20488.
OIM POT REPAIRS	59968.	114221.	170756.	230519.	291208.	351456.	411685.	471887.	532229.	592572.
PDM DEPOT REP GENS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PDM POT CNDMNS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PDM POT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH DEPOT REP GENS	31703.	60394.	90232.	121792.	153783.	185629.	217476.	249323.	281169.	313015.
EOH POT CNDMNS	3941.	7508.	11218.	15141.	19119.	23078.	27037.	30996.	34955.	38915.
EOH POT REPAIRS	27762.	52886.	79014.	106651.	134664.	162552.	190439.	218327.	246214.	274102.
INIT DEPOT BACKLOG	36413.	36413.	36413.	36413.	36413.	36413.	36413.	36413.	36413.	36413.
POT CNDMNS OF BKLOG	1574.	1574.	1574.	1574.	1574.	1574.	1574.	1574.	1574.	1574.
POT REPS OF BKLOG	34839.	34839.	34839.	34839.	34839.	34839.	34839.	34839.	34839.	34839.
TOTAL DEPOT REPARABLES	130157.	214977.	303303.	396691.	491469.	585647.	679805.	773936.	868211.	962488.
TOTAL POT CNDMNS	7589.	13031.	18696.	24685.	30761.	36803.	42845.	48886.	54931.	60977.
TOTAL POT REPAIRS	122568.	201946.	284608.	372006.	460709.	548844.	636960.	725050.	813281.	901512.
ACTUAL DEPOT REPAIRS	103297.	182886.	266613.	354854.	444001.	532333.	620630.	708892.	797287.	885613.
FOURTH OVER POS	19271.	19060.	17998.	17152.	16709.	16511.	16331.	16158.	15994.	15899.
FOURTH SHORT POSITION	11803.	15156.	20183.	26049.	31757.	37416.	43255.	49098.	54996.	60934.
DUE IN/ON ORDER ASSETS	765.	765.	765.	765.	765.	765.	765.	765.	765.	765.
APPLIED ASSETS	622.	611.	616.	622.	624.	623.	623.	623.	623.	623.
SIXTH OVER POS	142.	154.	149.	143.	141.	142.	142.	142.	142.	142.
SIXTH SHORT POSITION	11181.	14544.	19568.	25427.	31133.	36793.	42632.	48475.	54373.	60311.

Table 11c: TIME PHASED NET BUY AND REPAIR REQUIREMENTS FOR END ITEM J057 (THOUSANDS OF DOLLARS)

FISC. YR	<--(1)-->	<-- 0 -->	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
LEADTIME FOR BUY												
0-1 YR			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1-2 YR		10758.	13827.	18320.	23602.	28770.	33922.	39244.	44571.	49949.	55327.	
2-3 YR	423.	718.	1248.	1825.	2363.	2871.	3388.	3904.	4424.	4984.		
TOT BUY	423.	11476.	15075.	20144.	25965.	31642.	37310.	43148.	48995.	54933.	55327.	0.
TOT REP			29410.	52166.	76081.	101364.	126922.	152256.	177587.	202909.	228272.	253605.

Table 12a: TOTAL GROSS REQUIREMENTS FOR END ITEM J079 (THOUSANDS OF DOLLARS)

FISCAL YEAR:	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
OIM OPER RQMT	34536.	70933.	108596.	147156.	183747.	218583.	250570.	280783.	308559.	336334.
BASE PIPELINE RQMT	1336.	1408.	1457.	1492.	1416.	1348.	1237.	1169.	1075.	1075.
DEPOT PIPELINE RQMT	3061.	3226.	3338.	3418.	3243.	3088.	2835.	2678.	2462.	2462.
BASE SAFETY LEV RQMT	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.
DEPOT SAFETY LEV RQMT	2439.	2504.	2547.	2577.	2511.	2450.	2347.	2281.	2187.	2187.
NEGOTIATED BASE S/L	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL OIM GROSS RQMT	41372.	78071.	115938.	154643.	190916.	225468.	256990.	286911.	314282.	342057.
PDM OPER RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PDM PIPELINE RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL PDM GROSS RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH OPER RQMT	78514.	161042.	246694.	334126.	417100.	496059.	568774.	637474.	700375.	763274.
EOH PIPELINE RQMT	321.	338.	351.	358.	340.	323.	298.	281.	258.	258.
TOTAL EOH GROSS RQMT	78835.	161380.	247045.	334483.	417439.	496383.	569072.	637755.	700633.	763532.
PREPOS WRM RQMT	15553.	14942.	14797.	14492.	14186.	14041.	14186.	14332.	14332.	14332.
OTHER WRM RQMT	23592.	23592.	23592.	23592.	23592.	23592.	23592.	23592.	23592.	23592.
ADDITIVE RQMTS	8705.	8705.	8705.	8705.	8705.	8705.	8705.	8705.	8705.	8705.
TOTAL AF GROSS RQMT	168575.	287206.	410590.	536431.	655357.	768708.	873063.	971815.	1062063.	1152740.

Table 12b: APPLICATION OF ASSETS FOR END ITEM J079 (THOUSANDS OF DOLLARS)

FISCAL YEAR:	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL AF GROSS RQMT	168575.	287206.	410590.	536431.	655357.	768708.	873063.	971815.	1062063.	1152740.
ON HAND SVC ASSETS	19510.	19510.	19510.	19510.	19510.	19510.	19510.	19510.	19510.	19510.
SVC ASSETS APPLIED	19311.	19333.	19356.	19380.	19402.	19422.	19442.	19460.	19476.	19493.
FIRST OVER POS	199.	177.	154.	131.	109.	88.	69.	51.	34.	17.
FIRST SHORT POSITION	149264.	267876.	391234.	517052.	635955.	749285.	853622.	952356.	1042588.	1133246.
BASE REP GENS	5403.	11097.	16989.	23021.	28746.	34196.	39200.	43927.	48273.	52618.
POT BASE CNDMN	46.	95.	145.	197.	246.	292.	335.	376.	413.	450.
POT BASE REPAIRS	5357.	11002.	16844.	22825.	28500.	33904.	38865.	43552.	47860.	52168.
ACTUAL BASE REPAIRS	5341.	10970.	16794.	22757.	28416.	33804.	38750.	43423.	47719.	52015.
SECOND OVER POS	16.	32.	50.	67.	84.	100.	115.	128.	141.	154.
SECOND SHORT POSITION	143923.	256906.	374439.	494294.	607539.	715480.	814871.	908932.	994870.	1081230.
OIM DEPOT REP GENS	29133.	59836.	91607.	124134.	155000.	184387.	211370.	236858.	260289.	283716.
OIM POT CNDMNS	2688.	5521.	8453.	11454.	14302.	17014.	19504.	21855.	24017.	26179.
OIM POT REPAIRS	26445.	54315.	83154.	112680.	140698.	167373.	191866.	215003.	236271.	257540.
PDM DEPOT REP GENS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PDM POT CNDMNS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PDM POT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH DEPOT REP GENS	78514.	161042.	246694.	334126.	417100.	496059.	568774.	637474.	700375.	763274.
EOH POT CNDMNS	3760.	7713.	11816.	16003.	19977.	23759.	27242.	30532.	33545.	36558.
EOH POT REPAIRS	74753.	153329.	234878.	318123.	397123.	472301.	541533.	606942.	666830.	726717.
INIT DEPOT BACKLOG	49573.	49573.	49573.	49573.	49573.	49573.	49573.	49573.	49573.	49573.
POT CNDMNS OF BKLOG	4345.	4345.	4345.	4345.	4345.	4345.	4345.	4345.	4345.	4345.
POT REPS OF BKLOG	45228.	45228.	45228.	45228.	45228.	45228.	45228.	45228.	45228.	45228.
TOTAL DEPOT REPARABLES	157220.	270451.	387870.	507833.	621674.	730020.	829717.	923907.	1010236.	1096567.
TOTAL POT CNDMNS	10794.	17580.	24614.	31803.	38625.	45118.	51091.	56733.	61908.	67082.
TOTAL POT REPAIRS	146426.	252872.	363257.	476030.	583049.	684901.	778626.	867175.	948330.	1029484.
ACTUAL DEPOT REPAIRS	126055.	233975.	345363.	458905.	566121.	668185.	761959.	850538.	931656.	1012901.
FOURTH OVER POS	20371.	18897.	17893.	17124.	16929.	16716.	16668.	16634.	16675.	16583.
FOURTH SHORT POSITION	17867.	22931.	29077.	35389.	41419.	47295.	52912.	58394.	63214.	68330.
DUE IN/ON ORDER ASSETS	29319.	29319.	29319.	29319.	29319.	29319.	29319.	29319.	29319.	29319.
APPLIED ASSETS	8954.	13012.	16985.	19614.	20633.	21263.	21505.	21706.	21879.	22053.
SIXTH OVER POS	20365.	16307.	12334.	9705.	8686.	8056.	7814.	7613.	7440.	7266.
SIXTH SHORT POSITION	8914.	9919.	12091.	15775.	20786.	26032.	31407.	36688.	41335.	46277.

Table 12c: TIME PHASED NET BUY AND REPAIR REQUIREMENTS FOR END ITEM J079 (THOUSANDS OF DOLLARS)

FISC. YR	<--(1)-->	<-- 0 -->	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
LEADTIME FOR BUY												
0-1 YR			618.	600.	613.	614.	604.	605.	623.	646.	657.	677.
1-2 YR		7426.	7441.	7738.	7990.	8347.	8886.	9613.	10346.	10911.	11596.	
2-3 YR	870.	1878.	3741.	7171.	11835.	16541.	21171.	25695.	29766.	34004.		
TOT BUY	870.	9303.	11800.	15509.	20438.	25502.	30660.	35914.	40736.	45562.	12253.	677.
TOT REP			15300.	27977.	41096.	54430.	66943.	78856.	89806.	100154.	109626.	119115.

Table 13a: TOTAL GROSS REQUIREMENTS FOR END ITEM TF033 (THOUSANDS OF DOLLARS)

FISCAL YEAR:	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
OIM OPER RQMT	85936.	171443.	261593.	352336.	441753.	531307.	620861.	710414.	799966.	889524.
BASE PIPELINE RQMT	2529.	2516.	2653.	2670.	2631.	2635.	2635.	2635.	2635.	2635.
DEPOT PIPELINE RQMT	6883.	6848.	7220.	7268.	7161.	7173.	7173.	7173.	7173.	7173.
BASE SAFETY LEV RQMT	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.
DEPOT SAFETY LEV RQMT	6707.	6691.	6870.	6893.	6842.	6847.	6847.	6847.	6847.	6847.
NEGOTIATED BASE S/L	654.	654.	654.	654.	654.	654.	654.	654.	654.	654.
TOTAL OIM GROSS RQMT	102708.	188152.	278986.	369822.	459042.	548613.	638169.	727722.	817275.	906833.
PDM OPER RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PDM PIPELINE RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL PDM GROSS RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH OPER RQMT	135294.	270589.	413228.	555875.	697050.	838226.	979404.	1120579.	1261755.	1402934.
EOH PIPELINE RQMT	391.	391.	412.	412.	408.	408.	408.	408.	408.	408.
TOTAL EOH GROSS RQMT	135685.	270979.	413639.	556287.	697456.	838634.	979812.	1120987.	1262163.	1403342.
PREPOS WRM RQMT	25610.	25023.	24435.	24044.	23456.	23260.	23260.	23260.	23260.	23260.
OTHER WRM RQMT	59580.	59580.	59580.	59580.	59580.	59580.	59580.	59580.	59580.	59580.
ADDITIVE RQMTS	2380.	2380.	2380.	2380.	2380.	2380.	2380.	2380.	2380.	2380.
TOTAL AF GROSS RQMT	325959.	546105.	779017.	1012115.	1241920.	1472478.	1703209.	1933944.	2164679.	2395412.

Table 13b: APPLICATION OF ASSETS FOR END ITEM TF033 (THOUSANDS OF DOLLARS)

FISCAL YEAR:	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL AF GROSS RQMT	325959.	546105.	779017.	1012115.	1241920.	1472478.	1703209.	1933944.	2164679.	2395412.
ON HAND SVC ASSETS	22944.	22944.	22944.	22944.	22944.	22944.	22944.	22944.	22944.	22944.
SVC ASSETS APPLIED	20715.	21398.	21674.	21905.	22099.	22281.	22351.	22416.	22457.	22490.
FIRST OVER POS	2229.	1546.	1271.	1039.	845.	663.	594.	528.	488.	454.
FIRST SHORT POSITION	305245.	524709.	757347.	990211.	1219821.	1450196.	1680859.	1911529.	2142221.	2372923.
BASE REP GENS	27086.	54037.	82452.	111056.	139239.	167467.	195694.	223922.	252149.	280374.
POT BASE CNDMN	10.	21.	31.	42.	53.	64.	74.	85.	96.	107.
POT BASE REPAIRS	27076.	54017.	82421.	111014.	139186.	167403.	195620.	223837.	252053.	280267.
ACTUAL BASE REPAIRS	27049.	54004.	82404.	110992.	139163.	167377.	195593.	223809.	252032.	280246.
SECOND OVER POS	27.	13.	16.	22.	24.	26.	27.	28.	21.	20.
SECOND SHORT POSITION	278197.	470703.	674942.	879218.	1080658.	1282817.	1485266.	1687718.	1890190.	2092672.
OIM DEPOT REP GENS	58849.	117405.	179141.	241287.	302514.	363841.	425171.	486498.	547823.	609153.
OIM POT CNDMNS	1305.	2604.	3973.	5351.	6709.	8069.	9429.	10789.	12149.	13509.
OIM POT REPAIRS	57544.	114801.	175168.	235936.	295806.	355772.	415742.	475710.	535674.	595644.
PDM DEPOT REP GENS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PDM POT CNDMNS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PDM POT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH DEPOT REP GENS	135294.	270589.	413228.	555875.	697050.	838226.	979404.	1120579.	1261755.	1402934.
EOH POT CNDMNS	5602.	11204.	17110.	23016.	28861.	34706.	40552.	46397.	52242.	58088.
EOH POT REPAIRS	129693.	259386.	396119.	532861.	668190.	803521.	938853.	1074184.	1209516.	1344849.
INIT DEPOT BACKLOG	46276.	46276.	46276.	46276.	46276.	46276.	46276.	46276.	46276.	46276.
POT CNDMNS OF BKLOG	3985.	3985.	3985.	3985.	3985.	3985.	3985.	3985.	3985.	3985.
POT REPS OF BKLOG	42291.	42291.	42291.	42291.	42291.	42291.	42291.	42291.	42291.	42291.
TOTAL DEPOT REPARABLES	240421.	434262.	638642.	843432.	1045843.	1248346.	1450854.	1653359.	1855868.	2058372.
TOTAL POT CNDMNS	10892.	17792.	25067.	32351.	39555.	46760.	53965.	61171.	68376.	75582.
TOTAL POT REPAIRS	229529.	416469.	613574.	811081.	1006288.	1201587.	1396887.	1592189.	1787490.	1982789.
ACTUAL DEPOT REPAIRS	208523.	397158.	596282.	795277.	991633.	1187945.	1384130.	1580199.	1776202.	1972100.
FOURTH OVER POS	21006.	19312.	17294.	15806.	14657.	13643.	12758.	11990.	11289.	10692.
FOURTH SHORT POSITION	69678.	73545.	78663.	83941.	89025.	94872.	101134.	107518.	113986.	120571.
DUE IN/ON ORDER ASSETS	18533.	18533.	18533.	18533.	18533.	18533.	18533.	18533.	18533.	18533.
APPLIED ASSETS	11720.	12982.	14147.	15250.	15996.	16232.	16418.	16509.	16627.	16744.
SIXTH OVER POS	6813.	5552.	4386.	3284.	2537.	2301.	2115.	2025.	1907.	1790.
SIXTH SHORT POSITION	57958.	60563.	64515.	68692.	73029.	78640.	84716.	91010.	97359.	103827.

Table 13c: TIME PHASED NET BUY AND REPAIR REQUIREMENTS FOR END ITEM TF033 (THOUSANDS OF DOLLARS)

FISC. YR	<--(1)-->	<-- 0 -->	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
LEADTIME FOR BUY												
0-1 YR			436.	455.	479.	503.	523.	550.	579.	609.	638.	668.
1-2 YR		16035.	16729.	17894.	19192.	20523.	22186.	24074.	26082.	28144.	30323.	
2-3 YR	41487.	43379.	46143.	48996.	51982.	55905.	60063.	64319.	68578.	72837.		
TOT BUY	41487.	59414.	63308.	67345.	71654.	76931.	82772.	88942.	95239.	101589.	30961.	668.
TOT REP			17060.	32177.	48143.	64069.	79747.	95413.	111071.	126709.	142340.	157956.

Table 14a: TOTAL GROSS REQUIREMENTS FOR END ITEM TF039 (THOUSANDS OF DOLLARS)

FISCAL YEAR:	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
OIM OPER RQMT	27014.	54532.	85532.	117940.	158156.	203522.	256644.	307855.	359068.	410281.
BASE PIPELINE RQMT	912.	929.	1046.	1094.	1357.	1531.	1793.	1728.	1728.	1728.
DEPOT PIPELINE RQMT	2488.	2535.	2855.	2985.	3704.	4179.	4893.	4717.	4717.	4717.
BASE SAFETY LEV RQMT	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.
DEPOT SAFETY LEV RQMT	3871.	3906.	4158.	4267.	4784.	5110.	5595.	5477.	5477.	5477.
NEGOTIATED BASE S/L	268.	268.	268.	268.	268.	268.	268.	268.	268.	268.
TOTAL OIM GROSS RQMT	34553.	62170.	93860.	126554.	168269.	214609.	269193.	320044.	371258.	422471.
PDM OPER RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PDM PIPELINE RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL PDM GROSS RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH OPER RQMT	34775.	72226.	112352.	155153.	208654.	267505.	337053.	403928.	470804.	537680.
EOH PIPELINE RQMT	1307.	1408.	1509.	1609.	2012.	2213.	2615.	2514.	2514.	2514.
TOTAL EOH GROSS RQMT	36083.	73634.	113860.	156762.	210665.	269716.	339668.	406442.	473318.	540194.
PREPOS WRM RQMT	43478.	43478.	43478.	48913.	54347.	59782.	70652.	76086.	76086.	76086.
OTHER WRM RQMT	147186.	147186.	147186.	147186.	147186.	147186.	147186.	147186.	147186.	147186.
ADDITIVE RQMTS	1442.	1442.	1442.	1442.	1442.	1442.	1442.	1442.	1442.	1442.
TOTAL AF GROSS RQMT	262782.	327947.	399861.	480891.	581945.	692772.	828179.	951244.	1069334.	1187423.

Table 14b: APPLICATION OF ASSETS FOR END ITEM TF039 (THOUSANDS OF DOLLARS)

FISCAL YEAR:	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL AF GROSS RQMT	262782.	327947.	399861.	480891.	581945.	692772.	828179.	951244.	1069334.	1187423.
ON HAND SVC ASSETS	38450.	38450.	38450.	38450.	38450.	38450.	38450.	38450.	38450.	38450.
SVC ASSETS APPLIED	18707.	19434.	20221.	21153.	22301.	23508.	25019.	26298.	27446.	28595.
FIRST OVER POS	19743.	19017.	18230.	17297.	16149.	14943.	13432.	12153.	11004.	9855.
FIRST SHORT POSITION	244075.	308514.	379642.	459740.	559646.	669265.	803161.	924946.	1041888.	1158829.
BASE REP GENS	4882.	9856.	15459.	21316.	28585.	36784.	46385.	55642.	64898.	74154.
POT BASE CNDMN	2.	4.	7.	10.	13.	16.	21.	25.	29.	33.
POT BASE REPAIRS	4880.	9852.	15452.	21307.	28572.	36768.	46364.	55617.	64869.	74121.
ACTUAL BASE REPAIRS	4825.	9742.	15281.	21071.	28257.	36387.	45906.	55067.	64228.	73389.
SECOND OVER POS	55.	109.	171.	236.	315.	381.	459.	550.	641.	732.
SECOND SHORT POSITION	239250.	298771.	364361.	438668.	531388.	632878.	757255.	869879.	977659.	1085440.
OIM DEPOT REP GENS	22131.	44676.	70073.	96624.	129571.	166737.	210258.	252216.	294170.	336128.
OIM POT CNDMNS	172.	347.	545.	751.	1008.	1297.	1635.	1961.	2288.	2614.
OIM POT REPAIRS	21959.	44329.	69528.	95872.	128563.	165441.	208623.	250254.	291884.	333513.
PDM DEPOT REP GENS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PDM POT CNDMNS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PDM POT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH DEPOT REP GENS	34775.	72226.	112352.	155153.	208654.	267505.	337053.	403928.	470804.	537680.
EOH POT CNDMNS	728.	1512.	2352.	3248.	4368.	5600.	7056.	8456.	9857.	11257.
EOH POT REPAIRS	34047.	70714.	110000.	151904.	204286.	261905.	329998.	395473.	460950.	526425.
INIT DEPOT BACKLOG	70931.	70931.	70931.	70931.	70931.	70931.	70931.	70931.	70931.	70931.
POT CNDMNS OF BKLOG	1007.	1007.	1007.	1007.	1007.	1007.	1007.	1007.	1007.	1007.
POT REPS OF BKLOG	69924.	69924.	69924.	69924.	69924.	69924.	69924.	69924.	69924.	69924.
TOTAL DEPOT REPARABLES	127838.	187834.	253357.	322705.	409150.	505169.	618241.	727073.	835908.	944741.
TOTAL POT CNDMNS	1907.	2867.	3904.	5007.	6383.	7904.	9699.	11425.	13151.	14878.
TOTAL POT REPAIRS	125931.	184967.	249453.	317699.	402769.	497267.	608543.	715650.	822758.	929865.
ACTUAL DEPOT REPAIRS	119515.	177974.	241868.	309684.	394151.	487810.	598124.	704285.	810434.	916582.
FOURTH OVER POS	6417.	6994.	7584.	8016.	8619.	9458.	10420.	11366.	12325.	13284.
FOURTH SHORT POSITION	119735.	120801.	122496.	128986.	137238.	145071.	159132.	165596.	167227.	168859.
DUE IN/ON ORDER ASSETS	12117.	12117.	12117.	12117.	12117.	12117.	12117.	12117.	12117.	12117.
APPLIED ASSETS	11085.	11138.	11180.	11237.	11307.	11378.	11479.	11541.	11567.	11594.
SIXTH OVER POS	1033.	980.	938.	880.	810.	739.	638.	576.	550.	524.
SIXTH SHORT POSITION	108650.	109663.	111317.	117749.	125931.	133692.	147653.	154055.	155660.	157265.

Table 14c: TIME PHASED NET BUY AND REPAIR REQUIREMENTS FOR END ITEM TF039 (THOUSANDS OF DOLLARS)

FISC. YR	<--(1)-->	<-- 0 -->	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
LEADTIME FOR BUY												
0-1 YR			3.	8.	14.	20.	27.	36.	46.	55.	65.	74.
1-2 YR		1654.	1720.	1835.	2167.	2648.	3238.	4294.	4823.	4986.	5149.	
2-3 YR	106993.	107935.	109468.	115562.	123256.	130418.	143314.	149176.	150609.	152042.		
TOT BUY	106993.	109589.	111191.	117405.	125437.	133085.	146579.	153506.	155477.	157083.	5214.	74.
TOT REP			3801.	5912.	8224.	10682.	13742.	17135.	21127.	24965.	28802.	32638.

Table 15a: TOTAL GROSS REQUIREMENTS FOR END ITEM B052 (THOUSANDS OF DOLLARS)

FISCAL YEAR:	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
OIM OPER RQMT	566726.	1034626.	1547412.	2115917.	2637548.	3147411.	3657268.	4167121.	4676833.	5186544.
BASE PIPELINE RQMT	10348.	8543.	9362.	10379.	9523.	9308.	9308.	9308.	9308.	9308.
DEPOT PIPELINE RQMT	25599.	21132.	23159.	25676.	23559.	23027.	23027.	23027.	23027.	23027.
BASE SAFETY LEV RQMT	685.	565.	637.	722.	672.	660.	660.	660.	660.	660.
DEPOT SAFETY LEV RQMT	25694.	23328.	24423.	25712.	24619.	24336.	24336.	24336.	24336.	24336.
NEGOTIATED BASE S/L	4056.	4056.	4056.	4056.	4056.	4056.	4056.	4056.	4056.	4056.
TOTAL OIM GROSS RQMT	633107.	1092257.	1609055.	2182467.	2699981.	3208797.	3718658.	4228513.	4738232.	5247971.
PDM OPER RQMT	51274.	98705.	142290.	184594.	225616.	265355.	303798.	342239.	380697.	419154.
PDM PIPELINE RQMT	1826.	1689.	1552.	1507.	1461.	1415.	1370.	1370.	1370.	1370.
TOTAL PDM GROSS RQMT	53101.	100395.	143843.	186101.	227077.	266770.	305166.	343611.	382066.	420523.
EOH OPER RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH PIPELINE RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL EOH GROSS RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PREPOS WRM RQMT	189748.	176195.	162641.	153605.	140052.	135534.	135534.	135534.	135534.	135534.
OTHER WRM RQMT	46855.	46855.	46855.	46855.	46855.	46855.	46855.	46855.	46855.	46855.
ADDITIVE RQMTS	16198.	16198.	16198.	16198.	16198.	16198.	16198.	16198.	16198.	16198.
TOTAL AF GROSS RQMT	939614.	1432495.	1979194.	2585826.	3130767.	3674756.	4223025.	4771193.	5319389.	5867659.

Table 15b: APPLICATION OF ASSETS FOR END ITEM B052 (THOUSANDS OF DOLLARS)

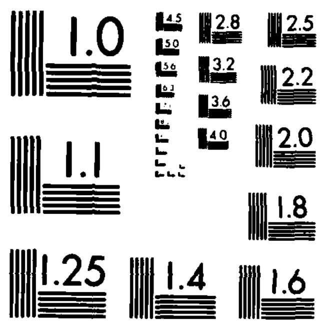
FISCAL YEAR:	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL AF GROSS RQMT	939614.	1432495.	1979194.	2585826.	3130767.	3674756.	4223025.	4771193.	5319389.	5867659.
ON HAND SVC ASSETS	121849.	121849.	121849.	121849.	121849.	121849.	121849.	121849.	121849.	121849.
SVC ASSETS APPLIED	98371.	100710.	102844.	104262.	105034.	105829.	106645.	107449.	108176.	108887.
FIRST OVER POS	23478.	21139.	19005.	17587.	16816.	16020.	15204.	14401.	13673.	12963.
FIRST SHORT POSITION	841252.	1331795.	1876358.	2481567.	3025740.	3568932.	4116385.	4663755.	5211242.	5758808.
BASE REP GENS	390701.	713269.	1066788.	1458717.	1818334.	2169833.	2521331.	2872832.	3224331.	3575831.
POT BASE CNDMN	85.	155.	232.	317.	395.	471.	547.	624.	700.	776.
POT BASE REPAIRS	390617.	713114.	1066556.	1458402.	1817940.	2169362.	2520784.	2872208.	3223631.	3575054.
ACTUAL BASE REPAIRS	388261.	709791.	1062351.	1453817.	1812977.	2164085.	2515198.	2866225.	3217282.	3568336.
SECOND OVER POS	2367.	3332.	4213.	4591.	4969.	5283.	5593.	5989.	6354.	6722.
SECOND SHORT POSITION	452992.	621977.	813965.	1027708.	1212710.	1404799.	1601139.	1797621.	1994146.	2190689.
OIM DEPOT REP GENS	176038.	321358.	480625.	657186.	819178.	977523.	1135877.	1294238.	1452592.	1610952.
OIM POT CNDMNS	1364.	2490.	3724.	5092.	6347.	7574.	8801.	10028.	11255.	12482.
OIM POT REPAIRS	174674.	318867.	476902.	652095.	812835.	969952.	1127075.	1284212.	1441339.	1598469
PDM DEPOT REP GENS	51274.	98705.	142290.	184594.	225616.	265355.	303798.	342239.	380697.	419154
PDM POT CNDMNS	1371.	2640.	3806.	4937.	6035.	7097.	8126.	9155.	10183.	11212.
PDM POT REPAIRS	49903.	96065.	138485.	179657.	219581.	258257.	295675.	333085.	370511.	407940
EOH DEPOT REP GENS	0.	0.	0.	0.	0.	0.	0.	0.	0	0
EOH POT CNDMNS	0.	0.	0.	0.	0.	0.	0.	0.	0	0
EOH POT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0	0
INIT DEPOT BACKLOG	219580.	219580.	219580.	219580.	219580.	219580.	219580.	219580.	219580.	219580
POT CNDMNS OF BKLOG	4966.	4966.	4966.	4966.	4966.	4966.	4966.	4966.	4966.	4966.
POT REPS OF BKLOG	214614.	214614.	214614.	214614.	214614.	214614.	214614.	214614.	214614.	214614
TOTAL DEPOT REPARABLES	446873.	639618.	842453.	1061326.	1264362.	1462458.	1659270.	1856087.	2052900.	2249715.
TOTAL POT CNDMNS	7701.	10096.	12496.	14995.	17348.	19637.	21892.	24148.	26403.	28659.
TOTAL POT REPAIRS	439171.	629525.	829958.	1046330.	1247014.	1442821.	1637378.	1831938.	2026494.	2221052.
ACTUAL DEPOT REPAIRS	297670.	483104.	681171.	896190.	1092911.	1287284.	1481681.	1676207.	1870759.	2065293.
FOURTH OVER POS	141516.	146438.	148805.	150150.	154109.	155544.	155706.	155739.	155745.	155765.
FOURTH SHORT POSITION	155326.	138889.	132803.	131519.	119800.	117514.	119455.	121414.	123389.	125377.
DUE IN/ON ORDER ASSETS	13625.	13625.	13625.	13625.	13625.	13625.	13625.	13625.	13625.	13625.
APPLIED ASSETS	10249.	10541.	10944.	11481.	11857.	12179.	12276.	12330.	12338.	12364.
SIXTH OVER POS	3377.	3084.	2682.	2144.	1768.	1446.	1349.	1295.	1287.	1261.
SIXTH SHORT POSITION	145078.	128348.	121860.	120038.	107943.	105335.	107179.	109084.	111051.	113033.

Table 15c: TIME PHASED NET BUY AND REPAIR REQUIREMENTS FOR END ITEM B052 (THOUSANDS OF DOLLARS)

FISC. YR	<--(1)-->	<-- 0 -->	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
LEADTIME FOR BUY												
0-1 YR			1064.	921.	845.	824.	711.	705.	750.	796.	842.	890.
1-2 YR		134238.	118604.	112697.	110927.	99780.	97035.	98227.	99479.	100793.	102121.	
2-3 YR	9776.	8823.	8317.	8288.	7453.	7595.	8202.	8809.	9416.	10023.		
TOT BUY	9776.	143061.	127985.	121905.	119225.	108199.	105947.	107741.	109645.	111612.	102963.	890.
TOT REP			53654.	87435.	122072.	158506.	192187.	225436.	258448.	291478.	324510.	357533.

AD-A152 014 MANAGING RECOVERABLE AIRCRAFT COMPONENTS IN THE PPB (PLANNING PROGRAMMING..(U) RAND CORP SANTA MONICA CA J BIGELOW JUN 84 RAND/R-3094-MIL MDA903-81-C-0381 3/5

UNCLASSIFIED F/G 5/1 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Table 16a: TOTAL GROSS REQUIREMENTS FOR END ITEM C005 (THOUSANDS OF DOLLARS)

FISCAL YEAR:	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
OIM OPER RQMT	50632.	102211.	160316.	221061.	296435.	381462.	481010.	577002.	672995.	768988.
BASE PIPELINE RQMT	777.	792.	892.	933.	1157.	1306.	1529.	1474.	1474.	1474.
DEPOT PIPELINE RQMT	1340.	1365.	1538.	1608.	1995.	2250.	2635.	2540.	2540.	2540.
BASE SAFETY LEV RQMT	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.	-0.
DEPOT SAFETY LEV RQMT	4833.	4879.	5178.	5295.	5895.	6261.	6777.	6654.	6654.	6654.
NEGOTIATED BASE S/L	2143.	2143.	2143.	2143.	2143.	2143.	2143.	2143.	2143.	2143.
TOTAL OIM GROSS RQMT	59726.	111390.	170068.	231039.	307624.	393420.	494094.	589815.	685807.	781802.
PDM OPER RQMT	49544.	96481.	146026.	192963.	242508.	289435.	338981.	396345.	474573.	552802.
PDM PIPELINE RQMT	1900.	1800.	1900.	1800.	1900.	1800.	1900.	2200.	3000.	3000.
TOTAL PDM GROSS RQMT	51444.	98281.	147926.	194763.	244408.	291235.	340880.	398544.	477573.	555802.
EOH OPER RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH PIPELINE RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL EOH GROSS RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PREPOS WRM RQMT	26424.	26424.	26424.	29726.	33030.	36333.	42939.	46242.	46242.	46242.
OTHER WRM RQMT	40909.	40909.	40909.	40909.	40909.	40909.	40909.	40909.	40909.	40909.
ADDITIVE RQMTS	16183.	16183.	16183.	16183.	16183.	16183.	16183.	16183.	16183.	16183.
TOTAL AF GROSS RQMT	195765.	294258.	402559.	513670.	643202.	779144.	936090.	1092780.	1267800.	1442022.

Table 16b: APPLICATION OF ASSETS FOR END ITEM C005 (THOUSANDS OF DOLLARS)

FISCAL YEAR:	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL AF GROSS RQMT	195765.	294258.	402559.	513670.	643202.	779144.	936090.	1092780.	1267800.	1442022.
ON HAND SVC ASSETS	31922.	31922.	31922.	31922.	31922.	31922.	31922.	31922.	31922.	31922.
SVC ASSETS APPLIED	29199.	29786.	30072.	30281.	30462.	30604.	30729.	30814.	30886.	30949.
FIRST OVER POS	2722.	2135.	1850.	1640.	1460.	1317.	1193.	1108.	1036.	972.
FIRST SHORT POSITION	166566.	264479.	372497.	483391.	612748.	748547.	905363.	1061970.	1236917.	1411075.
BASE REP GENS	39887.	80521.	126295.	174150.	233532.	300516.	378954.	454559.	530179.	605804.
POT BASE CNDMN	2.	3.	5.	7.	9.	12.	15.	18.	21.	24.
POT BASE REPAIRS	39886.	80518.	126290.	174143.	233523.	300504.	378939.	454541.	530158.	605779.
ACTUAL BASE REPAIRS	34449.	74905.	120702.	168776.	228444.	295687.	374484.	450262.	525891.	601526.
SECOND OVER POS	5437.	5613.	5589.	5367.	5079.	4817.	4456.	4281.	4270.	4256.
SECOND SHORT POSITION	132116.	189573.	251813.	314626.	384311.	452859.	530877.	611692.	711007.	809532.
OIM DEPOT REP GENS	10745.	21690.	34020.	46910.	62906.	80950.	102080.	122450.	142821.	163192.
OIM POT CNDMNS	421.	850.	1333.	1839.	2465.	3173.	4001.	4799.	5597.	6396.
OIM POT REPAIRS	10324.	20840.	32686.	45071.	60440.	77778.	98079.	117651.	137223.	156796.
PDM DEPOT REP GENS	49544.	96481.	146026.	192963.	242508.	289435.	338981.	396345.	474573.	552802.
PDM POT CNDMNS	120.	233.	353.	466.	586.	699.	819.	957.	1146.	1335.
PDM POT REPAIRS	49424.	96248.	145673.	192497.	241922.	288737.	338162.	395387.	473426.	551467.
EOH DEPOT REP GENS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH POT CNDMNS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH POT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
INIT DEPOT BACKLOG	30630.	30630.	30630.	30630.	30630.	30630.	30630.	30630.	30630.	30630.
POT CNDMNS OF BKLOG	1853.	1853.	1853.	1853.	1853.	1853.	1853.	1853.	1853.	1853.
POT REPS OF BKLOG	28777.	28777.	28777.	28777.	28777.	28777.	28777.	28777.	28777.	28777.
TOTAL DEPOT REPARABLES	90918.	148801.	210676.	270504.	336016.	400998.	471669.	549404.	648003.	746601.
TOTAL POT CNDMNS	2394.	2937.	3539.	4158.	4905.	5725.	6673.	7610.	8597.	9584.
TOTAL POT REPAIRS	88524.	145865.	207137.	266346.	331113.	395275.	464997.	541796.	639407.	737019.
ACTUAL DEPOT REPAIRS	78765.	135794.	197040.	256365.	321497.	385903.	456238.	533230.	631081.	728705.
FOURTH OVER POS	9760.	10071.	10098.	9982.	9624.	9378.	8766.	8575.	8335.	8322.
FOURTH SHORT POSITION	53350.	53778.	54773.	58275.	62812.	66960.	74642.	78462.	79929.	80829.
DUE IN/ON ORDER ASSETS	10048.	10048.	10048.	10048.	10048.	10048.	10048.	10048.	10048.	10048.
APPLIED ASSETS	7901.	7941.	7975.	8020.	8083.	8141.	8215.	8260.	8304.	8360.
SIXTH OVER POS	2147.	2107.	2073.	2028.	1966.	1908.	1833.	1789.	1745.	1689.
SIXTH SHORT POSITION	45449.	45837.	46798.	50255.	54730.	58819.	66426.	70203.	71625.	72469.

Table 16c: TIME PHASED NET BUY AND REPAIR REQUIREMENTS FOR END ITEM C005 (THOUSANDS OF DOLLARS)

FISC. YR	<--(1)-->	<-- 0 -->	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
LEADTIME FOR BUY												
0-1 YR			872.	888.	920.	983.	1096.	1200.	1379.	1469.	1521.	1568.
1-2 YR		9207.	9474.	9960.	11002.	12424.	13751.	16090.	17428.	18298.	18883.	
2-3 YR	35371.	35475.	35918.	38270.	41211.	43869.	48958.	51306.	51807.	52019.		
TOT BUY	35371.	44681.	46264.	49118.	53133.	57276.	63804.	68594.	70613.	71786.	20404.	1568.
TOT REP			10041.	16802.	24078.	31133.	38900.	46561.	54929.	64084.	75745.	87350.

Table 17a: TOTAL GROSS REQUIREMENTS FOR END ITEM C135 (THOUSANDS OF DOLLARS)

FISCAL YEAR:	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
OIM OPER RQMT	350942.	701756.	1057981.	1412454.	1794631.	2179688.	2564557.	2949153.	3335152.	3721153.
BASE PIPELINE RQMT	5970.	5968.	6060.	6030.	6502.	6551.	6547.	6543.	6567.	6567.
DEPOT PIPELINE RQMT	12690.	12685.	12881.	12817.	13818.	13923.	13916.	13906.	13957.	13957.
BASE SAFETY LEV RQMT	54.	54.	55.	54.	59.	59.	59.	59.	59.	59.
DEPOT SAFETY LEV RQMT	16486.	16483.	16610.	16569.	17206.	17271.	17267.	17261.	17292.	17292.
NEGOTIATED BASE S/L	15175.	15175.	15175.	15175.	15175.	15175.	15175.	15175.	15175.	15175.
TOTAL OIM GROSS RQMT	401312.	752117.	1108758.	1463097.	1847390.	2232667.	2617520.	3002090.	3388196.	3774203.
PDM OPER RQMT	47175.	94352.	141261.	188170.	235078.	281981.	328881.	375789.	422692.	469602.
PDM PIPELINE RQMT	2376.	2376.	2363.	2363.	2363.	2363.	2363.	2363.	2363.	2363.
TOTAL PDM GROSS RQMT	49552.	96729.	143624.	190532.	237441.	284344.	331244.	378150.	425055.	471965.
EOH OPER RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH PIPELINE RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL EOH GROSS RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PREPOS WRM RQMT	194904.	193210.	193210.	193210.	193210.	193210.	193210.	193210.	193210.	193210.
OTHER WRM RQMT	24920.	24920.	24920.	24920.	24920.	24920.	24920.	24920.	24920.	24920.
ADDITIVE RQMTS	9992.	9992.	9992.	9992.	9992.	9992.	9992.	9992.	9992.	9992.
TOTAL AF GROSS RQMT	681506.	1077776.	1481331.	1882587.	2313782.	2745968.	3177726.	3609215.	4042229.	4475032.

Table 17b: APPLICATION OF ASSETS FOR END ITEM C135 (THOUSANDS OF DOLLARS)

FISCAL YEAR:	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL AF GROSS RQMT	681506.	1077776.	1481331.	1882587.	2313782.	2745968.	3177726.	3609215.	4042229.	4475032.
ON HAND SVC ASSETS	131512.	131512.	131512.	131512.	131512.	131512.	131512.	131512.	131512.	131512.
SVC ASSETS APPLIED	121627.	123909.	125047.	125653	126099.	126464.	126816.	127125.	127353.	127550.
FIRST OVER POS	9885.	7603.	6465.	5859.	5413.	5049.	4697.	4387.	4159.	3962.
FIRST SHORT POSITION	559889.	953875.	1356290.	1756937.	2187688.	2619509.	3050916.	3482092.	3914877.	4347560.
BASE REP GENS	269721.	539324.	813113.	1085525.	1379238.	1675171.	1970962.	2266540.	2563195.	2859852.
POT BASE CNDMN	792.	1583.	2387.	3186.	4048.	4917.	5785.	6652.	7523.	8394.
POT BASE REPAIRS	268930.	537741.	810727.	1082342.	1375189.	1670255.	1965175.	2259889.	2555672.	2851458.
ACTUAL BASE REPAIRS	258014.	528390.	802766.	1075206.	1368933.	1664856.	1960536.	2255914.	2552426.	2848921.
SECOND OVER POS	10920.	9356.	7966.	7141.	6263.	5404.	4643.	3979.	3247.	2541.
SECOND SHORT POSITION	301883.	425493.	553527.	681707.	818718.	954614.	1090344.	1226143.	1362411.	1498632.
OIM DEPOT REP GENS	81230.	162430.	244887.	326928.	415381.	504499.	593577.	682596.	771932.	861272.
OIM POT CNDMNS	2831.	5660.	8533.	11392.	14474.	17580.	20684.	23786.	26899.	30012.
OIM POT REPAIRS	78400.	156771.	236354.	315536.	400908.	486921.	572895.	658810.	745034.	831260.
PDM DEPOT REP GENS	47175.	94352.	141261.	188170.	235078.	281981.	328881.	375789.	422692.	469602.
PDM POT CNDMNS	1544.	3089.	4624.	6160.	7695.	9231.	10766.	12302.	13837.	15373.
PDM POT REPAIRS	45631.	91264.	136637.	182010.	227383.	272752.	318115.	363488.	408855.	454230.
EOH DEPOT REP GENS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH POT CNDMNS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH POT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
INIT DEPOT BACKLOG	150353.	150353.	150353.	150353.	150353.	150353.	150353.	150353.	150353.	150353.
POT CNDMNS OF BKLOG	5499.	5499.	5499.	5499.	5499.	5499.	5499.	5499.	5499.	5499.
POT REPS OF BKLOG	144854.	144854.	144854.	144854.	144854.	144854.	144854.	144854.	144854.	144854.
TOTAL DEPOT REPARABLES	278758.	407119.	536468.	665412.	800777.	936808.	1072797.	1208726.	1344977.	1481231.
TOTAL POT CNDMNS	9874.	14248.	18656.	23051.	27668.	32309.	36948.	41586.	46234.	50883.
TOTAL POT REPAIRS	268887.	392871.	517816.	642362.	773107.	904496.	1035848.	1167138.	1298742.	1430346.
ACTUAL DEPOT REPAIRS	164082.	285801.	409826.	534055.	664991.	796138.	927167.	1058170.	1189505.	1320848.
FOURTH OVER POS	104805.	107084.	108010.	108325.	108132.	108378.	108695.	108982.	109251.	109510.
FOURTH SHORT POSITION	137805.	139698.	143711.	147653.	153729.	158480.	163177.	167975.	172909.	177784.
DUE IN/ON ORDER ASSETS	18028.	18028.	18028.	18028.	18028.	18028.	18028.	18028.	18028.	18028.
APPLIED ASSETS	12613.	13463.	14498.	15623.	16566.	16742.	16831.	16859.	16877.	16894.
SIXTH OVER POS	5415.	4565.	3530.	2405.	1462.	1286.	1197.	1169.	1151.	1134.
SIXTH SHORT POSITION	125193.	126235.	129213.	132030.	137163.	141738.	146346.	151116.	156033.	160890.

Table 17c: TIME PHASED NET BUY AND REPAIR REQUIREMENTS FOR END ITEM C135 (THOUSANDS OF DOLLARS)

FISC. YR	<--(1)-->	<-- 0 -->	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
LEADTIME FOR BUY												
0-1 YR			18453.	18287.	18364.	18397.	18620.	18684.	18741.	18839.	18947.	19046.
1-2 YR		64690.	65193.	66818.	68450.	71549.	74663.	77723.	80809.	83998.	87162.	
2-3 YR	42050.	42755.	44031.	45183.	46994.	48391.	49883.	51468.	53088.	54682.		
TOT BUY	42050.	107445.	127677.	130288.	133809.	138337.	143165.	147875.	152638.	157519.	106109.	19046.
TOT REP			34147.	58896.	84210.	109511.	136214.	162932.	189603.	216240.	242936.	269623.

The rows of the gross requirements tables are slightly different from the rows of the individual item in Table 2. In Table 2, the base order-and-ship requirement and base repair cycle requirement are stated separately. Here they are combined into the base pipeline requirement. The distinction between job routing and nonjob routing in the PDM and EOH requirements is not maintained in these tables, and some of the subtotals have been omitted.

Where the gross requirement tables have been simplified, the asset application tables have been made somewhat more complicated. In Table 3, we report serviceable assets, and the first over and short positions. In the present tables, we add a row showing the serviceable assets that were applied. This can be obtained from the other numbers by subtraction in either Table 3 or the present tables. In Table 3, however, the subtraction is unnecessary, since the applied serviceable assets for a single item equal either the total gross requirement or the total serviceables on hand. But for some items the applied assets will equal the one, and for some items the other, so that the applied serviceable assets, when aggregated over items, are equal to neither. It is no longer trivial to calculate the applied assets from other lines in the table. For the same reason, we have added lines showing how much is applied of each category of assets, including actual base repairs, actual depot repairs, and due in/on order assets.

Where in Table 3 we report only the total potential depot repairs, in the present tables we break out the potential repairs by source--i.e., OIM, PDM, EOH, and backlog.

Instead of reporting a single number for the sixth short position (i.e., the buy requirement), we separate it into three groups. In one group we put all items with procurement (administrative plus production) lead times of less than one year. In the next group we put all items with procurement lead times between one and two years. All remaining items are in the third group. This is not necessary in the single-item computation worksheet because each item has only one lead time and falls into only one of the groups. But for any end item, there are items falling into several of the groups. Finally, we add a row showing the cost of repairing the items that are actually repaired at the depot.

Table 18a: TOTAL GROSS REQUIREMENTS FOR END ITEM C141 (THOUSANDS OF DOLLARS)

FISCAL YEAR:	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
OIM OPER RQMT	133904.	268518.	408725.	549901.	692023.	834422.	976820.	1119224.	1261625.	1404025.
BASE PIPELINE RQMT	2278.	2290.	2386.	2402.	2418.	2423.	2423.	2423.	2423.	2423.
DEPOT PIPELINE RQMT	5172.	5199.	5415.	5453.	5489.	5500.	5500.	5500.	5500.	5500.
BASE SAFETY LEV RQMT	72.	73.	75.	75.	76.	76.	76.	76.	76.	76.
DEPOT SAFETY LEV RQMT	9754.	9780.	9983.	10018.	10052.	10061.	10061.	10061.	10061.	10061.
NEGOTIATED BASE S/L	3358.	3358.	3358.	3358.	3358.	3358.	3358.	3358.	3358.	3358.
TOTAL OIM GROSS RQMT	154539.	289215.	429943.	571203.	713414.	855838.	998238.	1140641.	1283042.	1425443.
PDM OPER RQMT	22539.	45079.	67619.	90159.	112698.	135239.	157779.	180319.	202860.	225399.
PDM PIPELINE RQMT	864.	864.	864.	864.	864.	864.	864.	864.	864.	864.
TOTAL PDM GROSS RQMT	23403.	45943.	68483.	91023.	113563.	136103.	158643.	181183.	203723.	226263.
EOH OPER RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH PIPELINE RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL EOH GROSS RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PREPOS WRM RQMT	60282.	60282.	60282.	60282.	60282.	60282.	60282.	60282.	60282.	60282.
OTHER WRM RQMT	95077.	95077.	95077.	95077.	95077.	95077.	95077.	95077.	95077.	95077.
ADDITIVE RQMTS	2682.	2682.	2682.	2682.	2682.	2682.	2682.	2682.	2682.	2682.
TOTAL AF GROSS RQMT	335987.	493199.	656454.	820259.	985010.	1149975.	1314919.	1479861.	1644808.	1809753.

Table 18b: APPLICATION OF ASSETS FOR END ITEM C141 (THOUSANDS OF DOLLARS)

FISCAL YEAR:	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL AF GROSS RQMT	335987.	493199.	656454.	820259.	985010.	1149975.	1314919.	1479861.	1644808.	1809753.
ON HAND SVC ASSETS	92640.	92640.	92640.	92640.	92640.	92640.	92640.	92640.	92640.	92640.
SVC ASSETS APPLIED	88850.	90316.	90770.	90945.	91078.	91168.	91221.	91258.	91294.	91328.
FIRST OVER POS	3790.	2324.	1869.	1694.	1561.	1472.	1418.	1381.	1346.	1312.
FIRST SHORT POSITION	247139.	402888.	565691.	729317.	893933.	1058811.	1223699.	1388607.	1553514.	1718424.
BASE REP GENS	91719.	183924.	279960.	376661.	474013.	571553.	669088.	766630.	864172.	961712.
POT BASE CNDMN	56.	113.	172.	232.	292.	352.	412.	472.	532.	592.
POT BASE REPAIRS	91663.	183811.	279787.	376429.	473721.	571201.	668677.	766159.	863640.	961121.
ACTUAL BASE REPAIRS	86605.	180377.	276764.	373715.	471189.	568875.	666540.	764148.	861751.	959351.
SECOND OVER POS	5058.	3434.	3025.	2714.	2532.	2326.	2137.	2012.	1890.	1770.
SECOND SHORT POSITION	160533.	222514.	288935.	355609.	422749.	489936.	557156.	624456.	691758.	759066.
OIM DEPOT REP GENS	42184.	84592.	128764.	173240.	218016.	262879.	307738.	352600.	397461.	442319.
OIM POT CNDMNS	901.	1808.	2752.	3702.	4659.	5618.	6576.	7535.	8494.	9452.
OIM POT REPAIRS	41282.	82785.	126012.	169538.	213357.	257261.	301161.	345064.	388968.	432867.
PDM DEPOT REP GENS	22539.	45079.	67619.	90159.	112698.	135239.	157779.	180319.	202860.	225399.
PDM POT CNDMNS	2632.	5264.	7896.	10528.	13160.	15792.	18423.	21055.	23687.	26319.
PDM POT REPAIRS	19908.	39815.	59723.	79631.	99539.	119447.	139355.	159263.	179171.	199079.
EOH DEPOT REP GENS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH POT CNDMNS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH POT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
INIT DEPOT BACKLOG	88130.	88130.	88130.	88130.	88130.	88130.	88130.	88130.	88130.	88130.
POT CNDMNS OF BKLOG	2810.	2810.	2810.	2810.	2810.	2810.	2810.	2810.	2810.	2810.
POT REPS OF BKLOG	85320.	85320.	85320.	85320.	85320.	85320.	85320.	85320.	85320.	85320.
TOTAL DEPOT REPARABLES	152855.	217803.	284511.	351527.	418832.	486228.	553628.	621026.	688430.	755831.
TOTAL POT CNDMNS	6343.	9881.	13457.	17040.	20628.	24219.	27809.	31399.	34990.	38581.
TOTAL POT REPAIRS	146512.	207922.	271056.	334488.	398208.	462011.	525821.	589627.	653440.	717250.
ACTUAL DEPOT REPAIRS	93971.	152910.	215839.	279217.	343032.	406876.	470753.	534690.	598629.	662568.
FOURTH OVER POS	52540.	55012.	55219.	55272.	55181.	55143.	55073.	54945.	54816.	54686.
FOURTH SHORT POSITION	66561.	69604.	73098.	76397.	79727.	83068.	86407.	89768.	93132.	96498.
DUE IN/ON ORDER ASSETS	12740.	12740.	12740.	12740.	12740.	12740.	12740.	12740.	12740.	12740.
APPLIED ASSETS	9479.	10280.	10623.	10893.	11081.	11163.	11208.	11248.	11288.	11327.
SIXTH OVER POS	3260.	2459.	2117.	1847.	1659.	1576.	1532.	1492.	1452.	1413.
SIXTH SHORT POSITION	57082.	59324.	62476.	65505.	68647.	71905.	75199.	78520.	81844.	85171.

Table 18c: TIME PHASED NET BUY AND REPAIR REQUIREMENTS FOR END ITEM C141 (THOUSANDS OF DOLLARS)

FISC. YR	<--(1)-->	<-- 0 -->	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
LEADTIME FOR BUY												
0-1 YR			1979.	2094.	2221.	2350.	2480.	2610.	2744.	2878.	3012.	3147.
1-2 YR		35180.	35852.	36807.	37640.	38497.	39349.	40192.	41039.	41888.	42739.	
2-3 YR	19924.	21379.	23448.	25514.	27670.	29947.	32264.	34604.	36945.	39286.		
TOT BUY	19924.	56558.	61278.	64414.	67531.	70794.	74093.	77406.	80727.	84051.	45751.	3147.
TOT REP			18038.	27568.	37495.	47488.	57546.	67606.	77669.	87746.	97824.	107902.

Table 19a: TOTAL GROSS REQUIREMENTS FOR END ITEM F004 (THOUSANDS OF DOLLARS)

FISCAL YEAR:	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
OIM OPER RQMT	1057647.	2172294.	3325725.	4506583.	5626962.	6693802.	7673389.	8598708.	9449341.	10300015.
BASE PIPELINE RQMT	20460.	21562.	22312.	22844.	21677.	20638.	18950.	17901.	16456.	16456.
DEPOT PIPELINE RQMT	70199.	73982.	76554.	78378.	74376.	70809.	65017.	61418.	56458.	56458.
BASE SAFETY LEV RQMT	1856.	1985.	2066.	2143.	2025.	1920.	1748.	1634.	1482.	1482.
DEPOT SAFETY LEV RQMT	55264.	56851.	57889.	58634.	57062.	55619.	53181.	51603.	49392.	49392.
NEGOTIATED BASE S/L	15481.	15481.	15481.	15481.	15481.	15481.	15481.	15481.	15481.	15481.
TOTAL OIM GROSS RQMT	1220893.	2342156.	3500031.	4684022.	5797564.	6858297.	7827755.	8746762.	9588597.	10439229.
PDM OPER RQMT	120203.	238141.	357677.	477556.	595818.	709214.	816783.	919493.	1016370.	1110009.
PDM PIPELINE RQMT	4590.	4503.	4565.	4578.	4516.	4330.	4107.	3922.	3699.	3575.
TOTAL PDM GROSS RQMT	124794.	242644.	362242.	482133.	600334.	713545.	820893.	923415.	1020068.	1113582.
EOH OPER RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH PIPELINE RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL EOH GROSS RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PREPOS WRM RQMT	1100423.	1057144.	1047917.	1026278.	1004638.	995412.	1004638.	1013867.	1013867.	1013867.
OTHER WRM RQMT	32843.	32843.	32843.	32843.	32843.	32843.	32843.	32843.	32843.	32843.
ADDITIVE RQMTS	29659.	29659.	29659.	29659.	29659.	29659.	29699.	29659.	29659.	29659.
TOTAL AF GROSS RQMT	2509074.	3704927.	4972995.	6255223.	7465488.	8630137.	9716150.	10746860.	11685380.	12629578.

Table 19b: APPLICATION OF ASSETS FOR END ITEM F004 (THOUSANDS OF DOLLARS)

FISCAL YEAR:	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL AF GROSS RQMT	2509074.	3704927.	4972995.	6255223.	7465488.	8630137.	9716150.	10746860.	11685380.	12629578.
ON HAND SVC ASSETS	405468.	405468.	405468.	405468.	405468.	405468.	405468.	405468.	405468.	405468.
SVC ASSETS APPLIED	265944.	276295.	282338.	287708.	292424.	296877.	300995.	304881.	308432.	311759.
FIRST OVER POS	139553.	129197.	123153.	117780.	113064.	108611.	104494.	100607.	97055.	93728.
FIRST SHORT POSITION	2243146.	3428635.	4690727.	5967540.	7173075.	8333292.	9415217.	10441998.	11376984.	12317819.
BASE REP GENS	709084.	1456367.	2229669.	3021390.	3772688.	4487934.	5144543.	5764882.	6335164.	6905483.
POT BASE CNDMN	354.	728.	1115.	1510.	1886.	2244.	2572.	2882.	3167.	3452.
POT BASE REPAIRS	708729.	1455639.	2228553.	3019879.	3770801.	4485693.	5141975.	5762007.	6331998.	6902034.
ACTUAL BASE REPAIRS	700069.	1443010.	2212794.	3000932.	3748719.	4460749.	5114192.	5731373.	6298694.	6866305.
SECOND OVER POS	8665.	12639.	15764.	18953.	22087.	24954.	27797.	30651.	33325.	35751.
SECOND SHORT POSITION	1543073.	1985578.	2478014.	2966851.	3424653.	3872867.	4301242.	4710756.	5078303.	5451555.
OIM DEPOT REP GENS	348560.	715915.	1096029.	1485213.	1854514.	2206124.	2528970.	2833943.	3114289.	3394639.
OIM POT CNDMNS	6983.	14342.	21956.	29752.	37150.	44194.	50661.	56770.	62386.	68002.
OIM POT REPAIRS	341577.	701572.	1074076.	1455459.	1817365.	2161928.	2478307.	2777175.	3051903.	3326637.
PDM DEPOT REP GENS	120203.	238141.	357677.	477556.	595818.	709214.	816783.	919493.	1016370.	1110009.
PDM POT CNDMNS	6428.	12734.	19127.	25538.	31861.	37925.	43678.	49170.	54350.	59357.
PDM POT REPAIRS	113775.	225406.	338550.	452016.	563957.	671291.	773105.	870322.	962020.	1050649.
EOH DEPOT REP GENS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH POT CNDMNS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH POT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
INIT DEPOT BACKLOG	276856.	276856.	276856.	276856.	276856.	276856.	276856.	276856.	276856.	276856.
POT CNDMNS OF BKLOG	12991.	12991.	12991.	12991.	12991.	12991.	12991.	12991.	12991.	12991.
POT REPS OF BKLOG	263867.	263867.	263867.	263867.	263867.	263867.	263867.	263867.	263867.	263867.
TOTAL DEPOT REPARABLES	745584.	1230874.	1730564.	2239634.	2727214.	3192224.	3622636.	4030323.	4407493.	4781318.
TOTAL POT CNDMNS	26400.	40065.	54074.	68280.	82002.	95110.	107329.	118931.	129727.	140350.
TOTAL POT REPAIRS	719181.	1190808.	1676492.	2171354.	2645213.	3097112.	3515303.	3911393.	4277818.	4641001.
ACTUAL DEPOT REPAIRS	558820.	1026992.	1511695.	2004513.	2475309.	2924997.	3341842.	3737244.	4102113.	4465021.
FOURTH OVER POS	160391.	163830.	164810.	166856.	169912.	172121.	173472.	174159.	175715.	176079.
FOURTH SHORT POSITION	984247.	958577.	966308.	962319.	949327.	947848.	959385.	973651.	976419.	986668.
DUE IN/ON ORDER ASSETS	81283.	81283.	81283.	81283.	81283.	81283.	81283.	81283.	81283.	81283.
APPLIED ASSETS	37315.	38121.	42174.	42859.	43253.	43640.	43839.	43996.	44004.	44105.
SIXTH OVER POS	43967.	43162.	39109.	38424.	38030.	37642.	37443.	37287.	37279.	37178.
SIXTH SHORT POSITION	946931.	920455.	924135.	919461.	906076.	904207.	915548.	929658.	932416.	942563.

Table 19c: TIME PHASED NET BUY AND REPAIR REQUIREMENTS FOR END ITEM F004 (THOUSANDS OF DOLLARS)

FISC. YR	<--(1)-->	<-- 0 -->	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
LEADTIME FOR BUY												
0-1 YR			4727.	4583.	4651.	4640.	4599.	4632.	4749.	4882.	4939.	5048.
1-2 YR		694042.	675015.	678568.	676869.	668872.	669388.	679732.	691956.	695716.	704709.	
2-3 YR	248167.	240864.	240921.	237958.	232612.	230195.	231072.	232825.	231765.	232809.		
TOT BUY	248167.	934902.	920657.	921103.	914126.	903700.	905052.	917183.	928465.	933403.	709647.	5048.
TOT REP			78221.	145738.	215881.	287216.	355275.	420248.	480352.	537318.	589832.	642152.

Table 20a: TOTAL GROSS REQUIREMENTS FOR END ITEM F015 (THOUSANDS OF DOLLARS)

FISCAL YEAR:	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
OIM OPER RQMT	249679.	519310.	812140.	1127936.	1443435.	1807685.	2217622.	2679602.	3223196.	3766793.
BASE PIPELINE RQMT	4736.	5114.	5554.	5990.	5984.	6909.	7776.	8763.	10311.	10311.
DEPOT PIPELINE RQMT	10211.	11028.	11976.	12915.	12903.	14897.	16766.	18894.	22232.	22232.
BASE SAFETY LEV RQMT	51.	56.	67.	55.	16.	19.	21.	24.	28.	26.
DEPOT SAFETY LEV RQMT	12563.	13074.	13645.	14172.	14135.	15219.	16162.	17185.	18695.	18670.
NEGOTIATED BASE S/L	19564.	19564.	19564.	19564.	19564.	19564.	19564.	19564.	19564.	19564.
TOTAL OIM GROSS RQMT	296801.	568145.	862946.	1180631.	1496029.	1864290.	2277910.	2744028.	3294025.	3837594.
PDM OPER RQMT	4968.	9936.	14904.	22416.	28354.	34655.	40309.	49276.	58363.	67572.
PDM PIPELINE RQMT	189.	189.	189.	286.	226.	239.	215.	341.	345.	350.
TOTAL PDM GROSS RQMT	5157.	10125.	15093.	22702.	28579.	34894.	40524.	49617.	58709.	67922.
EOH OPER RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH PIPELINE RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL EOH GROSS RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PREPOS WRM RQMT	178599.	188688.	198778.	215416.	232053.	252232.	275951.	299670.	340025.	370294.
OTHER WRM RQMT	22139.	22139.	22139.	22139.	22139.	22139.	22139.	22139.	22139.	22139.
ADDITIVE RQMTS	10103.	10103.	10103.	10103.	10103.	10103.	10103.	10103.	10103.	10103.
TOTAL AF GROSS RQMT	512958.	799363.	1109221.	1451145.	1789063.	2183816.	2626787.	3125720.	3725163.	4308210.

Table 20b: APPLICATION OF ASSETS FOR END ITEM F015 (THOUSANDS OF DOLLARS)

FISCAL YEAR:	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL AF GROSS RQMT	512958.	799363.	1109221.	1451145.	1789063.	2183816.	2626787.	3125720.	3725163.	4308210.
ON HAND SVC ASSETS	113625.	113625.	113625.	113625.	113625.	113625.	113625.	113625.	113625.	113625.
SVC ASSETS APPLIED	64476.	72524.	81003.	88953.	93906.	95264.	96635.	98138.	99419.	100622.
FIRST OVER POS	49149.	41101.	32621.	24672.	19718.	18360.	16990.	15487.	14206.	13003.
FIRST SHORT POSITION	448484.	726839.	1028218.	1362200.	1695162.	2088558.	2530153.	3027583.	3625747.	4207594.
BASE REP GENS	183006.	380634.	595271.	826737.	1057988.	1324977.	1625451.	1964060.	2362492.	2760928.
POT BASE CNDMN	87.	180.	282.	392.	502.	628.	771.	931.	1120.	1309.
POT BASE REPAIRS	182920.	380454.	594988.	826345.	1057487.	1324349.	1624680.	1963129.	2361372.	2759619.
ACTUAL BASE REPAIRS	176263.	367077.	574244.	798790.	1025977.	1292630.	1592694.	1930790.	2329343.	2727714.
SECOND OVER POS	6657.	13378.	20744.	27555.	31510.	31720.	31986.	32341.	32030.	31907.
SECOND SHORT POSITION	272224.	359758.	453968.	563404.	669186.	795932.	937467.	1096792.	1296395.	1479872.
OIM DEPOT REP GENS	66673.	138674.	216870.	301194.	385444.	482711.	592179.	715544.	860702.	1005861.
OIM POT CNDMNS	1494.	3107.	4859.	6749.	8637.	10816.	13269.	16033.	19286.	22538.
OIM POT REPAIRS	65179.	135567.	212010.	294446.	376807.	471894.	578910.	699510.	841416.	983323.
PDM DEPOT REP GENS	4968.	9936.	14904.	22416.	28354.	34655.	40309.	49276.	58363.	67572.
PDM POT CNDMNS	14.	27.	41.	61.	78.	95.	110.	135.	160.	185.
PDM POT REPAIRS	4954.	9909.	14863.	22355.	28276.	34560.	40199.	49141.	58204.	67387.
EOH DEPOT REP GENS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH POT CNDMNS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH POT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
INIT DEPOT BACKLOG	62821.	62821.	62821.	62821.	62821.	62821.	62821.	62821.	62821.	62821.
POT CNDMNS OF BKLOG	2415.	2415.	2415.	2415.	2415.	2415.	2415.	2415.	2415.	2415.
POT REPS OF BKLOG	60406.	60406.	60406.	60406.	60406.	60406.	60406.	60406.	60406.	60406.
TOTAL DEPOT REPARABLES	134461.	211431.	294593.	386432.	476617.	580187.	695309.	827641.	981887.	1136249.
TOTAL POT CNDMNS	3923.	5550.	7315.	9226.	11130.	13326.	15795.	18584.	21861.	25139.
TOTAL POT REPAIRS	130539.	205881.	287277.	377206.	465487.	566861.	679514.	809057.	960027.	1111116.
ACTUAL DEPOT REPAIRS	113329.	188431.	269823.	360154.	448776.	550912.	664502.	794939.	947494.	1098521.
FOURTH OVER POS	17210.	17450.	17456.	17053.	16711.	15949.	15014.	14118.	12533.	12595.
FOURTH SHORT POSITION	158895.	171329.	184149.	203250.	220409.	245020.	272964.	301854.	348905.	381353.
DUE IN/ON ORDER ASSETS	55025.	55025.	55025.	55025.	55025.	55025.	55025.	55025.	55025.	55025.
APPLIED ASSETS	37324.	38043.	38537.	38954.	39323.	39830.	40418.	40962.	41639.	42543.
SIXTH OVER POS	17701.	16982.	16488.	16071.	15702.	15195.	14607.	14063.	13386.	12482.
SIXTH SHORT POSITION	121571.	133287.	145612.	164297.	181086.	205190.	232546.	260894.	307266.	338810.

Table 20c: TIME PHASED NET BUY AND REPAIR REQUIREMENTS FOR END ITEM F015 (THOUSANDS OF DOLLARS)

FISC. YR	<--(1)-->	<-- 0 -->	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
LEADTIME FOR BUY												
0-1 YR			1558.	1704.	1852.	2080.	2290.	2585.	2931.	3285.	3875.	4284.
1-2 YR		46471.	50953.	55709.	62916.	69604.	78552.	88763.	99375.	116664.	128983.	
2-3 YR	73543.	80629.	88051.	99301.	109192.	124053.	140851.	158234.	186729.	205545.		
TOT BUY	73543.	127100.	140562.	156714.	173960.	195737.	221693.	249583.	289034.	325491.	132859.	4284.
TOT REP			10394.	16383.	22879.	30102.	37200.	45398.	54510.	64972.	77158.	89261.

Table 21a: TOTAL GROSS REQUIREMENTS FOR END ITEM F016 (THOUSANDS OF DOLLARS)

FISCAL YEAR:	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
OIM OPER RQMT	213953.	538355.	944365.	1424030.	1966647.	2574032.	3279237.	4067820.	4943139.	5818479.
BASE PIPELINE RQMT	5060.	7674.	9603.	11345.	12834.	14366.	16679.	18651.	20708.	20708.
DEPOT PIPELINE RQMT	20384.	30910.	38682.	45699.	51697.	57869.	67188.	75133.	83423.	83423.
BASE SAFETY LEV RQMT	4.	5.	6.	6.	7.	8.	9.	10.	11.	11.
DEPOT SAFETY LEV RQMT	17482.	21571.	24149.	26275.	27923.	29532.	31844.	33683.	35552.	35474.
NEGOTIATED BASE S/L	50386.	50386.	50386.	50386.	50386.	50386.	50386.	50386.	50386.	50386.
TOTAL OIM GROSS RQMT	307260.	648904.	1067193.	1557745.	2109497.	2726196.	3445346.	4245683.	5133111.	6008521.
PDM OPER RQMT	80.	162.	242.	510.	774.	965.	1159.	1532.	1932.	2306.
PDM PIPELINE RQMT	3.	3.	3.	11.	11.	8.	8.	16.	17.	16.
TOTAL PDM GROSS RQMT	84.	165.	245.	521.	785.	973.	1167.	1548.	1948.	2322.
EOH OPER RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH PIPELINE RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
TOTAL EOH GROSS RQMT	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
PREPOS WRM RQMT	293688.	434894.	533293.	609910.	685773.	772904.	893087.	1002002.	1089132.	1132700.
OTHER WRM RQMT	18434.	18434.	18434.	18434.	18434.	18434.	18434.	18434.	18434.	18434.
ADDITIVE RQMTS	12606.	12606.	12606.	12606.	12606.	12606.	12606.	12606.	12606.	12606.
TOTAL AF GROSS RQMT	632053.	1115013.	1631785.	2199226.	2827105.	3531122.	4370534.	5279891.	6255108.	7174529.

Table 21b: APPLICATION OF ASSETS FOR END ITEM F016 (THOUSANDS OF DOLLARS)

FISCAL YEAR:	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL AF GROSS RQMT	632053.	1115013.	1631785.	2199226.	2827105.	3531122.	4370534.	5279891.	6255108.	7174529.
ON HAND SVC ASSETS	22364.	22364.	22364.	22364.	22364.	22364.	22364.	22364.	22364.	22364.
SVC ASSETS APPLIED	21882.	22042.	22082.	22124.	22158.	22193.	22221.	22222.	22222.	22222.
FIRST OVER POS	483.	322.	282.	240.	207.	172.	144.	142.	142.	142.
FIRST SHORT POSITION	610176.	1092971.	1609704.	2177104.	2804948.	3508929.	4348338.	5257683.	6232859.	7152329.
BASE REP GENS	59240.	149072.	261490.	394288.	544531.	712707.	907968.	1126315.	1368755.	1611198.
POT BASE CNDMN	0.	1.	2.	3.	4.	5.	7.	8.	10.	12.
POT BASE REPAIRS	59240.	149071.	261488.	394285.	544527.	712702.	907961.	1126306.	1368744.	1611185.
ACTUAL BASE REPAIRS	59200.	149019.	261440.	394241.	544485.	712663.	907929.	1126279.	1368718.	1611160.
SECOND OVER POS	40.	51.	48.	45.	43.	40.	32.	28.	26.	26.
SECOND SHORT POSITION	550975.	943952.	1348263.	1782850.	2260453.	2796254.	3440487.	4131772.	4864430.	5541294.
OIM DEPOT REP GENS	154712.	389288.	682881.	1029729.	1422105.	1861315.	2371259.	2941496.	3574654.	4207813.
OIM POT CNDMNS	1589.	3999.	7015.	10579.	14610.	19121.	24360.	30218.	36722.	43227.
OIM POT REPAIRS	153123.	385288.	675864.	1019149.	1407494.	1842192.	2346897.	2911278.	3537931.	4164584.
PDM DEPOT REP GENS	80.	162.	242.	510.	774.	965.	1159.	1532.	1932.	2306.
PDM POT CNDMNS	19.	39.	58.	121.	184.	230.	276.	365.	460.	549.
PDM POT REPAIRS	61.	123.	184.	388.	590.	735.	883.	1167.	1472.	1757.
EOH DEPOT REP GENS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH POT CNDMNS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
EOH POT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
INIT DEPOT BACKLOG	8795.	8795.	8795.	8795.	8795.	8795.	8795.	8795.	8795.	8795.
POT CNDMNS OF BKLOG	227.	227.	227.	227.	227.	227.	227.	227.	227.	227.
POT REPS OF BKLOG	8568.	8568.	8568.	8568.	8568.	8568.	8568.	8568.	8568.	8568.
TOTAL DEPOT REPARABLES	163587.	398245.	691916.	1039034.	1431676.	1871075.	2381213.	2951823.	3585381.	4218916.
TOTAL POT CNDMNS	1835.	4265.	7300.	10927.	15021.	19578.	24863.	30810.	37409.	44003.
TOTAL POT REPAIRS	161752.	393979.	684616.	1028105.	1416652.	1851494.	2356347.	2921014.	3547972.	4174911.
ACTUAL DEPOT REPAIRS	161054.	393433.	684227.	1027842.	1416397.	1851238.	2356105.	2920804.	3547793.	4174738.
FOURTH OVER POS	698.	546.	388.	264.	255.	257.	242.	210.	180.	173.
FOURTH SHORT POSITION	389920.	550490.	664005.	754976.	844026.	944985.	1084350.	1210938.	1316861.	1366934.
DUE IN/ON ORDER ASSETS	67668.	67668.	67668.	67668.	67668.	67668.	67668.	67668.	67668.	67668.
APPLIED ASSETS	56695.	57390.	57779.	58087.	58289.	58498.	58673.	58822.	58944.	58997.
SIXTH OVER POS	10973.	10278.	9889.	9581.	9379.	9170.	8995.	8846.	8724.	8671.
SIXTH SHORT POSITION	333231.	493102.	606229.	696892.	785737.	886491.	1025680.	1152117.	1257917.	1307940.

Table 21c: TIME PHASED NET BUY AND REPAIR REQUIREMENTS FOR END ITEM F016 (THOUSANDS OF DOLLARS)

FISC. YR	<--(1)-->	<-- 0 -->	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
LEADTIME FOR BUY												
0-1 YR			1494.	1892.	2181.	2424.	2650.	2900.	3259.	3587.	3891.	4012.
1-2 YR		39676.	54720.	66084.	75936.	85503.	96173.	110777.	124333.	136922.	143358.	
2-3 YR	292083.	436514.	537989.	618555.	697609.	787442.	911669.	1024224.	1117129.	1160596.		
TOT BUY	292083.	476168.	594177.	686508.	775702.	875344.	1010470.	1137876.	1244693.	1301080.	147249.	4012.
TOT REP			31833.	77930.	135607.	203768.	280815.	367021.	467132.	579133.	703485.	827815.

The earlier row giving actual depot repairs valued the items at their purchase price, to be consistent with the other asset application steps.

Figure 4a shows gross requirements for all end items together separated into operating and level requirements. This figure makes it clear how different these quantities are. Clearly, the gross requirement for any year is the sum of a level requirement that hardly changes from year to year and an operating requirement that accumulates. The picture would be scarcely different for any individual end item, although the rate of buildup of operating requirements, as compared to the level requirement, differs among end items (see Tables 10-21).

In Fig. 4b we look separately at the operating requirement. Instead of showing the total in each year, this figure shows the increment that is added in each year. Incremental annual operating requirements are mostly OIM operating requirements; the PDM and EOH programs contribute relatively little. And incremental annual operating requirements are quite steady from year to year.

Figure 4c shows the level requirement. This is made up mostly of war reserve requirements, with a substantial contribution from peacetime OIM level requirements. All other levels--additives, stock to support PDM and EOH programs, etc.--are tiny by comparison.

Next we turn to the aggregate asset application tables. Figure 5a shows, for all end items together, which are the important sources of assets in satisfying the gross requirement. The biggest contributors are repair at both base and depot in approximately equal amounts. The buy requirement merely serves to "top things off." We note that all assets in this figure are measured in terms of their purchase price. The "depot repair" segment, for example, depicts the value of the items that must be repaired at the depot, not the cost of repairing them.

The information to produce similar figures for individual end items can be found in Tables 10-21. The major difference one will find between end items is that for engines, base repair plays a very small role and depot repair a correspondingly larger one. For aircraft, base repairs are somewhat more important and depot repairs less so (although still important) than indicated in Fig. 5a.

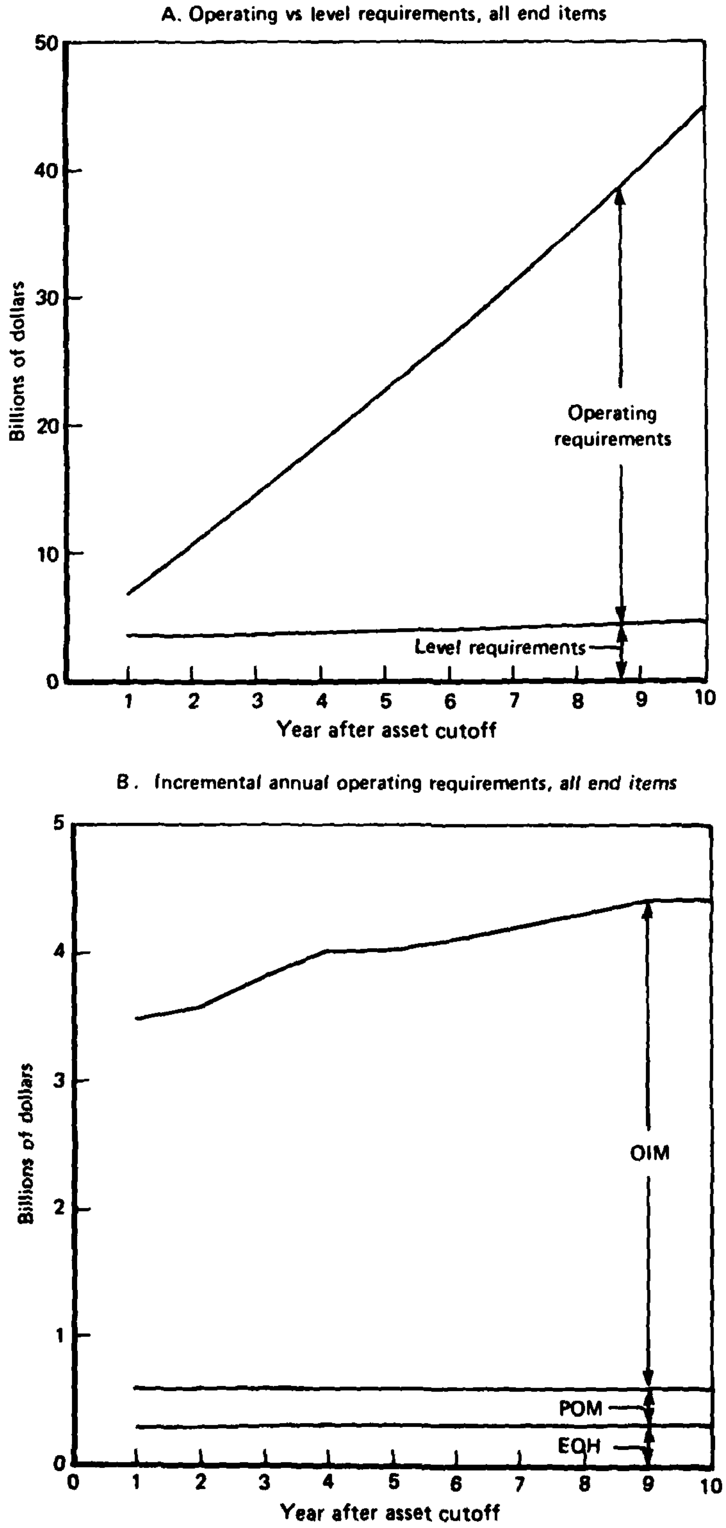


Fig. 4 — Makeup of gross requirements

C. Level requirements, all end items

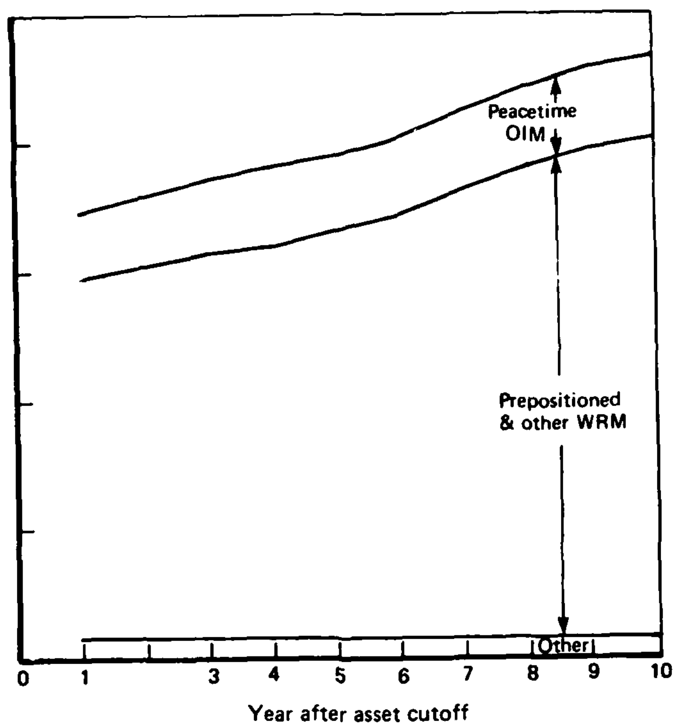


Fig. 4 – Makeup of gross requirements (cont.)

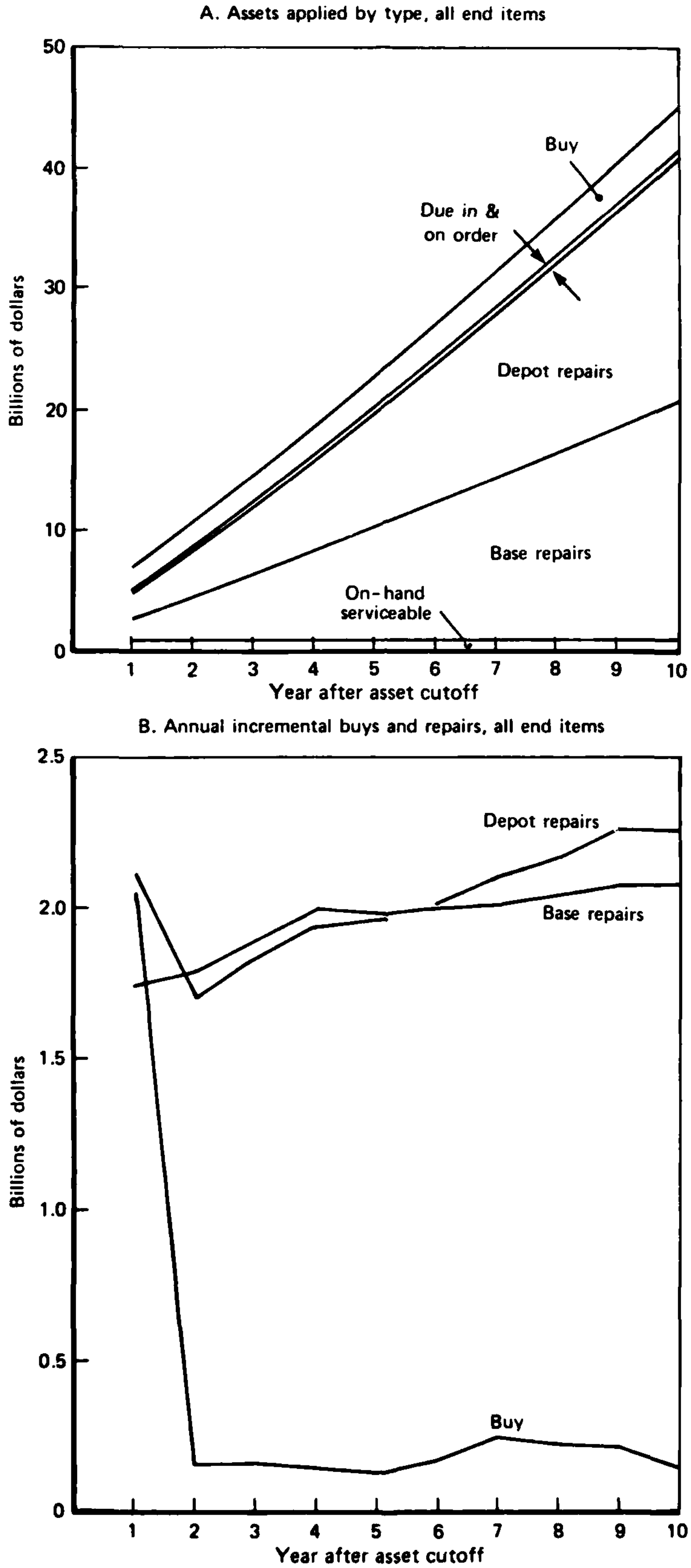


Fig. 5 — How gross requirement is satisfied

Figure 5a shows the requirements and applied assets cumulated over time, as D041 computes them. It is useful, however, to difference the assets applied in successive years to determine how much must be bought or repaired in individual years. This is done in Fig. 5b. Note that annual incremental base and depot repairs are quite steady and approximately equal. But the buy requirement has a huge spike in the first year and then dwindles to almost nothing.

In part, this may be because our extract from the D041 database gives component inventories as of March 1980, whereas the flying programs are from the PA 84-1, which gives flying hours starting from 1982. For an end item being procured in the 1980-1982 period, such as the F-15, F-16, and F100 engine, the components destined to be acquired between 1980 and 1982 presumably make up part of the spike. However, such a spike occurs in the buy requirements for every end item (see Tables 10-21) and not just for end items where numbers were increasing between 1980 and 1982.

We can advance three other possible explanations for the spike. First, it may be that in years before asset cutoff, too little money was provided to entirely satisfy the buy requirement. This will result in the unfunded portion being carried over to the years following asset cutoff. And if the entire first year buy requirement is not funded, the unfunded portion will also be carried over into the future. Thus, Fig. 5b shows a buy requirement in the first year of about \$1.3 billion, and only \$50 million in year 2. But the proper statement is that \$1.3 billion is required by the end of year 1 and \$1.3 billion plus \$50 million by the end of year 2. A failure to fund the entire \$1.3 billion requirement in year 1 will not alter the cumulative \$1.35 billion requirement by the end of year 2.

The second reason is that a program change may have resulted in a change in requirements. The buy program for the F-16 may have been accelerated, for example, resulting in an increase in the peacetime flying activity. The wartime planning scenario may be changed. We know such changes occur; indeed, it is to enable us to adjust to such changes that ORACLE was developed.

The third possible reason is that the wrong components may have been bought in previous years. If a component has a high demand rate in one year, it is likely to have a high buy requirement. If a component is bought and in a subsequent year its demand rate drops, that component will be in a surplus position. To some degree, this phenomenon is inevitable. If a component is made obsolete by a modification, for example, its demands may drop to zero; but the component was needed at one time, and the fact that there is now a surplus does not mean it was a mistake to buy the component then. But it is also true that hindsight can identify numerous "bad buys."

D041 assumes that these mistakes of the past can be corrected by the first year buy, and that they will not recur thereafter. But, of course, these "mistakes" will continue. D041 "forecasts" requirements for a series of future years that are completely predictable in all respects. Every component's demands per flying hour, repair and transportation times, condemnation rates, etc., are assumed known. No new components are assumed to enter the inventory except those anticipated at the time of the computation. Future programs are assumed not to change in subsequent PPB cycles. Obviously, all of these quantities cannot be anticipated perfectly. Some of them are certain to change by the time D041's prediction is due, and D041 is flawed by its failure to consider that unanticipated contingencies will arise. The ORACLE database inherits this flaw, since it is developed directly from D041 (or an alternative system) and is structured to reproduce the results that D041 would obtain. In Sec. 6.3 we will discuss the forecasting problem more fully.

To the extent that the spike is due to this third reason, there are serious implications for the use of ORACLE. If there were large, frequent, unanticipated changes in demand rates and other factors for most components, then the D041 projections of requirements for future years would be very poor, even if programs were stable. It would be unwise to use ORACLE to help build budgets for years in which the underlying D041 methodology did poorly. However, in the work reported here, we had no means for estimating how much of the spike was due to each cause we have identified, and therefore how serious are the

implications of this phenomenon for the use of ORACLE. In Sec. 6.3 we will renew the discussion of the forecasting problem.

Finally, in Tables 10-21 the buy requirement is split among items with zero to one year lead times, one to two year lead times, and longer lead times. For each end item, only a small portion of the buy requirement is for items with the shortest lead times. For the older end items (the J-57 and J-79 engines, the B-52, C-135, and F-4 aircraft), most of the buy requirement is concentrated among items with a one to two year lead time, while for the newer end items (the F100, TF-33, and TF-39 engines, and the C-5, F-15, and F-16 aircraft), most of the buy requirement is for two to three year lead time items. For the C-141, the one to two year and two to three year items buys are approximately the same. It is interesting to note how much of the first (and even second) year buy requirement consists of items with such long lead times that it is already too late to acquire them by the time they are needed. Taken over all end items, there is a buy requirement for over $1.3 billion for such items.

5.3.2. Operating and Pipeline Requirement Factors

As we pointed out in Sec. 4, it is straightforward to calculate factors that relate the expected pipeline contents and the operating requirements to the OIM, PDM, and EOH programs. These factors can be used to provide diagnostic information to identify some of the important reasons that the requirements are as large (or small) as they are. The factors are shown in Table 22a for engines and Table 22b for aircraft.

Recall that the programs appear in two forms in the equations for the pipeline and operating requirements. The pipeline requirements depend on the rate at which an activity occurs: the flying hours per year for the OIM program, the PDMs per year, or the engine overhauls per year. The operating requirements, on the other hand, depend on the total cumulative amount of an activity: total flying hours or PDMs or EOHs accumulated since asset cutoff. (Recall that the operating requirements are cumulated over the years in the D041 computation.) The tables contain factors that relate to each form of program.

Table 22a: Factors Relating Programs to Operating and Pipeline Requirements: Engines

	END ITEM				
FACTOR DESCRIPTION	F100	J057	J079	TF033	TF039
	FACTORS RELATING TO DEACCUMULATED OIM PROGRAM				
PURCHASE PRICE (DOLLARS/FH) OF:					
BASE PIPELINE RQMT/FH	21.79	5.31	7.60	6.86	17.17
DEPOT PIPELINE RQMT/FH	104.66	24.19	17.42	18.67	46.86
	FACTORS RELATING TO ACCUMULATED OIM PROGRAM				
PURCHASE PRICE (DOLLARS/FH) OF:					
OIM OPERATING RQMT/FH	579.22	159.13	196.50	233.11	508.69
POT BASE REPS/FH	10.34	18.55	30.48	73.45	91.90
POT BASE CND/FH	0.01	0.04	0.26	0.03	0.04
POT DEPOT REPS/FH	536.86	135.85	150.46	156.10	413.51
POT DEPOT CND/FH	32.01	4.70	15.29	3.54	3.24
REPAIR COST (DOLLARS/FH) OF:					
POT DEPOT REPS/FH	96.36	38.44	18.24	13.53	22.73
	FACTORS RELATING TO DEACCUMULATED PDM PROGRAM				
PURCHASE PRICE (DOLLARS/PDM) OF:					
DEPOT PIPELINE RQMT/PDM	0.00	0.00	0.00	0.00	0.00
	FACTORS RELATING TO ACCUMULATED PDM PROGRAM				
PURCHASE PRICE (DOLLARS/PDM) OF:					
OPERATING RQMT/PDM	0.00	0.00	0.00	0.00	0.00
POT DEPOT REPS/PDM	0.00	0.00	0.00	0.00	0.00
POT DEPOT CND/PDM	0.00	0.00	0.00	0.00	0.00
REPAIR COST (DOLLARS/PDM) OF:					
POT DEPOT REPS/PDM	0.00	0.00	0.00	0.00	0.00
	FACTORS RELATING TO DEACCUMULATED EOH PROGRAM				
PURCHASE PRICE (DOLLARS/EOH) OF:					
DEPOT PIPELINE RQMT	7160.67	4115.61	1826.49	4248.36	100574.69
	FACTORS RELATING TO ACCUMULATED EOH PROGRAM				
PURCHASE PRICE (DOLLARS/EOH) OF:					
OPERATING RQMT/EOH	190819.19	143453.62	446100.19	1470576.00	2675034.00
POT DEPOT REPS/EOH	120555.37	125619.12	424734.12	1409687.00	2619036.00
POT DEPOT CND/EOH	70264.06	17834.46	21366.25	60889.02	56003.30
REPAIR COST (DOLLARS/EOH) OF:					
POT DEPOT REPS/EOH	26394.35	37022.37	48847.02	107639.19	88756.25

Table 22b: Factors Relating Programs to Operating and Pipeline Requirements: Aircraft

FACTOR DESCRIPTION	END ITEM B052	C005	C135	C141	F004	F015	F016
			FACTORS RELATING TO DEACCUMULATED OIM PROGRAM				
PURCHASE PRICE (DOLLARS/FH) OF:							
BASE PIPELINE RQMT/FH	318.57	58.56	91.69	31.45	232.83	121.71	193.65
DEPOT PIPELINE RQMT/FH	788.07	100.94	194.89	71.39	798.81	262.42	780.06
			FACTORS RELATING TO ACCUMULATED OIM PROGRAM				
PURCHASE PRICE (DOLLARS/FH) OF:							
OIM OPERATING RQMT/FH	17448.32	3813.90	5389.67	1848.53	12035.15	6416.28	8186.92
POT BASE REPS/FH	12026.24	3004.43	4130.11	1265.40	8064.82	4700.69	2266.96
POT BASE CND/FH	2.61	0.12	12.16	0.78	4.03	2.23	0.02
POT DEPOT REPS/FH	5377.49	777.60	1204.04	569.90	3887.07	1674.98	5859.20
POT DEPOT CND/FH	41.99	31.72	43.47	12.44	79.46	38.39	60.82
REPAIR COST (DOLLARS/FH) OF:							
POT DEPOT REPS/FH	628.53	91.81	247.94	83.33	599.65	135.39	1161.69
			FACTORS RELATING TO DEACCUMULATED PDM PROGRAM				
PURCHASE PRICE (DOLLARS/PDM) OF:							
DEPOT PIPELINE RQMT/PDM	22831.05	100011.69	13502.50	13499.61	12371.62	1534.99	52.47
			FACTORS RELATING TO ACCUMULATED PDM PROGRAM				
PURCHASE PRICE (DOLLARS/PDM) OF:							
OPERATING RQMT/PDM	640950.19	2607569.00	268044.31	352183.00	323996.12	40390.04	1252.76
POT DEPOT REPS/PDM	623807.12	2601267.00	259270.31	311058.75	306670.75	40279.38	954.30
POT DEPOT CND/PDM	17143.60	6297.84	8774.27	41125.45	17325.52	110.66	298.46
REPAIR COST (DOLLARS/PDM) OF:							
POT DEPOT REPS/PDM	243956.31	310054.31	50637.56	56355.93	34525.67	3212.88	287.00
			FACTORS RELATING TO DEACCUMULATED EOH PROGRAM				
PURCHASE PRICE (DOLLARS/EOH) OF:							
DEPOT PIPELINE RQMT	31.41	0.00	96.83	46.99	4407.22	0.00	0.00
			FACTORS RELATING TO ACCUMULATED EOH PROGRAM				
PURCHASE PRICE (DOLLARS/EOH) OF:							
OPERATING RQMT/EOH	818.80	0.00	2524.40	3327.82	227749.25	0.00	0.00
POT DEPOT REPS/EOH	0.00	0.00	1703.38	0.00	204790.19	0.00	0.00
POT DEPOT CND/EOH	818.80	0.00	821.01	3327.82	22959.43	0.00	0.00
REPAIR COST (DOLLARS/EOH) OF:							
POT DEPOT REPS/EOH	0.00	0.00	402.83	0.00	28248.97	0.00	0.00

One may interpret these factors as follows. Let us take as an example the first column of Table 22a, the column that refers to the F100 engine. At the top we see that the base pipeline requirement per flying hour is $21.79. This is a pipeline requirement and hence depends on the flying rate, known in D041 jargon as the "de-accumulated OIM program." The factor tells us that if we increase the flying in any particular year by one flying hour, spread uniformly over the year, an additional $21.79 worth of components will move into the base pipelines (order-and-ship plus base repair cycle). Similarly, $104.66 worth of stock will move into the depot repair cycle pipeline.

Looking further, we see that the OIM operating requirement per flying hour is $579.22. This is an operating requirement and therefore depends on the flying hours accumulated since asset cutoff--the "accumulated OIM program" in the jargon of D041. If we increase by one the flying hours in a particular year, this factor tells us that the operating requirement accumulated through the end of that year will increase by $579.22; or equivalently, that additional items will have failed whose aggregate purchase price is $579.22. But because an increase in flying hours in one year increases the cumulative flying hours not only through the end of that year but through the end of every following year as well, this factor also tells us that the operating requirement has increased by a like amount in all following years. This may seem confusing, but it is a direct consequence of the fact that the operating requirement calculated by D041 is cumulated over years. The operating requirement reported for year 5, for example, is the sum of all failures from asset cutoff through the end of year 5; thus, any item failure in any of the years 1 through 5 will affect the year 5 operating requirement.

Now that we can interpret the factors, let us examine them. For engines we can draw few conclusions from the OIM factors. The F100 and TF-39 engines seem to have considerably higher costs per flying hour than the others, and there is little repair of engine components at base level.

Of course, all PDM-related factors are zero; engines are not repaired (beyond the usual intermediate-level repair) during PDM.

We read the following story in the EOH-related factors. The operating requirement factor tells us the value of the components that one expects to replace during an engine overhaul, either with repaired or new components. The potential depot repairs factor shows how much of the operating requirement can be repaired, and the potential depot condemnation factor tells how much will be condemned. The final factor relates the repair cost of potential depot repairs to the EOH program. Thus, the cost per EOH of repairing what can be repaired and replacing with new stock what must be condemned is the sum of the last two factors in a column. Remember that only the nonjob-routed repairs are included here.

With this interpretation, the TF-33 and TF-39 engines are seen to incur very high component-related costs during overhaul, the TF-33 almost $170,000 per overhaul and the TF-39 nearly $150,000. The F100 stands out as having a high proportion of condemned items as compared to repaired items.

Turning now to Table 22b, which gives the factors for aircraft, we note that the B-52, F-4, and F-16 stand out as having expensive OIM pipeline requirements per flying hour, compared to the other aircraft. The F-4 and F-16 further stand out as having a high ratio of depot to base OIM pipeline requirements. It would be interesting to discover why the F-15 is unlike the F-4 and F-16 in these respects, and why the transport aircraft appear to have such a relatively small requirement for OIM pipeline stock. (These features might be explained as due to characteristics of the aircraft, or just as likely they are characteristics of the extract from the D041 database we are using.)

One may learn quite a bit from the OIM operating requirement per flying hour, and the potential repairs and condemnations at base and depot. First, the F-16 stands out as an aircraft for which base repair is relatively ineffective. Over 70 percent of its operating requirement per flying hour is sent to wholesale to become potential depot repairs, compared with approximately 20 percent for the C-5 and C-135, 25 percent for the F-15, and 30 percent for the B-52, C-141, and F-4. A little

investigation revealed that in 1980, the vintage of our data, most components of the F-16 were still under manufacturer's warranty and hence were always repaired at the wholesale level.

The B-52 and F-4 distinguish themselves as being expensive to fly (operating requirements of $17,449 and $12,035 per flying hour, respectively). Perhaps this is a consequence of the age of these weapon systems. More likely, it stems from our choice of items in the extract, or a problem in selecting the QPAs for items that apply only to some series of an aircraft.

It is also possible to calculate the average base and depot OIM pipeline times from these factors. The average base pipeline time (a weighted average of the order-and-ship and the base repair cycle times) is the ratio of the base pipeline factor and the OIM operating requirements factor, multiplied by 365 to convert the answer into days. When one calculates the base pipeline time in this way, all the aircraft have times close to six days. The F-16 has a slightly longer time, 8.63 days. This reflects the fact that a larger fraction of F-16 items are sent to the depot for repair than is true of the other aircraft, and the order-and-ship time is generally longer than the base repair cycle time.

The depot pipeline time is calculated similarly, using the depot pipeline factor and the potential depot repairs factor. Looking at the depot pipeline times, one finds that all save one aircraft have times around 50 days. The exception is the F-4, which has a time of 75 days. We have no ready explanation for this.

The PDM related factors are extremely low for the F-15 and F-16, compared to the other aircraft. The Air Force intends that neither the F-15 nor the F-16 will ever have regularly scheduled visits to the depot--i.e., PDMs. But should it happen that these aircraft come to require depot-level work, even on an as-needed basis, the D041 database will need PDM (or equivalent) factors for the components of these aircraft if it is to make realistic projections of the component requirements arising from this source.

We have no explanation for the existence of nonzero EOH-related factors for aircraft. Nevertheless, such factors occur for the B-52, C-135, C-141, and F-4, although only the F-4 factors are significant. This agrees with our earlier observation that a significant number of

engine items are applied to the F-4 aircraft in our extract (see Fig. 3a).

5.3.3. Derivatives

Tables 23-34 show the derivatives calculated as described in Sec. 4. Each end item has its own set of tables. All Tables 23 refer to the F100 engine; Tables 24 refer to the J-57 engine; and so on. For any end item, each of its tables contains the derivatives of each of nine dependent variables (the rows) in ten years of projected requirements (the columns).

Each table contains derivatives with respect to a different independent variable. These independent variables are the quantities describing the peacetime programs and wartime scenarios for the different end items, including most of the quantities found in Tables 7, 8, and 9. For peacetime, the independent variables are:

- Target percentage of end item to be available (denoted as TFMCS(k) in Sec. 4.5).
- Percentage probability of achieving the target availability (TPROB(k) in Sec. 4.5).
- OIM "de-accumulated" program, (OIMPG(k,y) in Sec. 4.4).
- OIM "accumulated" program, (COIPR(k,y) in Sec. 4.4).
- PDM "de-accumulated" program, (PDMPG(k,y) in Sec. 4.4).
- PDM "accumulated" program (CPDPR(k,y) in Sec. 4.4).
- EOH "de-accumulated" program (EOHPG(k,y) in Sec. 4.4).
- EOH "accumulated" program (CEOPR (k,y) in Sec. 4.4).

Each end item, whether engine or aircraft, has a set of tables of derivatives with respect to its own peacetime program quantities. We have not included all eight peacetime tables for every end item, however, because certain tables contain nothing but zeroes. This is true of the PDM tables for all the engines and for the EOH tables for some of the aircraft. As mentioned earlier, there are some engine components that our extract from the D041 database identifies with aircraft rather than with engines, and these components are designated as having EOH-driven requirements.

Table 23a: Derivatives for End Item F100 with Respect to F100 Peacetime Target Percentage Availability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	4578.	4911.	5195.	5431.	5584.	5766.	6029.	6319.	6746.	6905.
SERVICEABLE ASSETS	129.	118.	112.	89.	66.	54.	54.	52.	51.	50.
BASE REPAIRS	0.	2.	2.	0.	3.	8.	2.	1.	5.	6.
VALUE DEPOT REPAIRS	120.	137.	148.	172.	173.	183.	199.	192.	171.	172.
ON ORDER ASSETS	329.	363.	393.	370.	396.	409.	330.	274.	287.	298.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	225.	244.	259.	276.	284.	294.	312.	330.	360.	368.
BUY OF 2-3 YR ITEMS	3776.	4048.	4281.	4525.	4662.	4818.	5133.	5471.	5872.	6011.
DPEM DOLLARS	16.	21.	26.	30.	35.	36.	40.	36.	37.	37.

Table 23b: Derivatives for End Item F100 with Respect to F100 Peacetime Target Percentage Probability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	41537.	45938.	49568.	52271.	53103.	55650.	58651.	61905.	66573.	66571.
SERVICEABLE ASSETS	1174.	1102.	1068.	857.	625.	523.	525.	510.	504.	480.
BASE REPAIRS	0.	14.	15.	1.	28.	82.	18.	11.	53.	58.
VALUE DEPOT REPAIRS	1086.	1280.	1408.	1653.	1649.	1767.	1935.	1882.	1683.	1662.
ON ORDER ASSETS	2986.	3396.	3749.	3563.	3762.	3947.	3209.	2680.	2830.	2870.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	2038.	2281.	2474.	2652.	2704.	2836.	3030.	3229.	3553.	3552.
BUY OF 2-3 YR ITEMS	34255.	37865.	40855.	43547.	44335.	46497.	49935.	53595.	57951.	57949.
DPEM DOLLARS	147.	197.	250.	292.	329.	343.	394.	355.	368.	356.

Table 23c: Derivatives for End Item F100 with Respect to F100 Deaccumulated OIM Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	148.	146.	145.	144.	144.	142.	141.	140.	140.	140.
SERVICEABLE ASSETS	6.	5.	4.	3.	2.	1.	1.	1.	1.	1.
BASE REPAIRS	0.	0.	0.	0.	0.	1.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	5.	4.	4.	5.	4.	4.	5.	4.	4.	4.
ON ORDER ASSETS	12.	12.	13.	12.	11.	11.	6.	5.	5.	5.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	13.	13.	13.	13.	13.	13.	13.	13.	13.	13.
BUY OF 2-3 YR ITEMS	112.	112.	111.	112.	112.	112.	116.	116.	117.	117.
DPEM DOLLARS	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.

Table 23d: Derivatives for End Item F100 with Respect to F100 Accumulated OIM Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	579.	579.	579.	579.	579.	579.	579.	579.	579.	579.
SERVICEABLE ASSETS	18.	16.	11.	8.	6.	3.	3.	2.	2.	1.
BASE REPAIRS	10.	10.	10.	10.	10.	13.	10.	10.	11.	11.
VALUE DEPOT REPAIRS	527.	528.	530.	533.	533.	533.	536.	537.	537.	537.
ON ORDER ASSETS	16.	18.	20.	20.	20.	20.	6.	5.	5.	5.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	1.	1.	1.	1.	2.	2.	2.	2.	2.	2.
BUY OF 2-3 YR ITEMS	7.	7.	7.	7.	9.	9.	23.	23.	23.	23.
DPEM DOLLARS	93.	94.	94.	95.	95.	95.	96.	97.	97.	96.

Table 23e: Derivatives for End Item F100 with Respect to F100 Deaccumulated EOH Program

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	7161.	7161.	7161.	7161.	7161.	7161.	7161.	7161.	7161.	7161.
SERVICEABLE ASSETS	2052.	2018.	1004.	918.	716.	631.	589.	528.	469.	288.
BASE REPAIRS	0.	0.	0.	0.	0.	16.	0.	1.	1.	1.
VALUE DEPOT REPAIRS	240.	223.	816.	853.	820.	440.	496.	498.	539.	484.
ON ORDER ASSETS	1317.	1368.	1788.	1798.	1984.	2431.	2060.	1883.	1845.	2080.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	116.	116.	118.	119.	121.	122.	125.	128.	134.	134.
BUY OF 2-3 YR ITEMS	3436.	3436.	3436.	3472.	3520.	3520.	3891.	4123.	4173.	4173.
DPEM DOLLARS	55.	63.	586.	594.	622.	215.	248.	251.	262.	250.

Table 23f: Derivatives for End Item F100 with Respect to F100 Accumulated EOH Program

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	190819.	190819.	190819.	190819.	190819.	190819.	190819.	190819.	190819.	190819.
SERVICEABLE ASSETS	53732.	52854.	26403.	23942.	18656.	16453.	15344.	13765.	12227.	7509.
BASE REPAIRS	0.	0.	0.	2.	6.	427.	10.	22.	20.	35.
VALUE DEPOT REPAIRS	111232.	110768.	126235.	127441.	127887.	121933.	123428.	123495.	124491.	123064.
ON ORDER ASSETS	24546.	25880.	36827.	37696.	41235.	48932.	39230.	34613.	34277.	40407.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	295.	295.	333.	367.	412.	450.	515.	594.	759.	759.
BUY OF 2-3 YR ITEMS	1017.	1024.	1024.	1374.	2627.	2627.	12295.	18333.	19048.	19048.
DPEM DOLLARS	18190.	18384.	32021.	32271.	33078.	26389.	27278.	27352.	27632.	27308.

Table 23g: Derivatives for End Item F100 with Respect to F015 Wartime Target Percentage Availability

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	976335.	1030562.	1084789.	1166006.	1247223.	1355674.	1491364.	1627054.	1843963.	2006645.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	15229.	6857.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	137580.	154456.	162599.	174942.	187285.	203571.	223799.	244027.	276599.	301027.
BUY OF 2-3 YR ITEMS	823526.	869249.	922190.	991065.	1059938.	1152107.	1267568.	1383032.	1567369.	1705622.
DPEM DOLLARS	3211.	1973.	0.	0.	0.	0.	0.	0.	0.	0.

Table 23h: Derivatives for End Item F100 with Respect to F015 Wartime Target Percentage Probability

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	115850.	122276.	128701.	138243.	147785.	160635.	176795.	192955.	218657.	237933.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	577.	249.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	15462.	16679.	17557.	18867.	20178.	21933.	24131.	26330.	29839.	32471.
BUY OF 2-3 YR ITEMS	99812.	105347.	111145.	119376.	127607.	138703.	152664.	166626.	188818.	205463.
DPEM DOLLARS	120.	72.	0.	0.	0.	0.	0.	0.	0.	0.

Table 23i:)erivatives for End Item F100 with Respect to F015 Sorties/Day Per Aircraft

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	15799147.	16677254.	17555344.	18875888.	20196352.	21952576.	24144480.	26336320.	29848752.	32483104.
SERVICEABLE ASSETS	219361.	172773.	107162.	100126.	107175.	2167.	2383.	2600.	2946.	3206.
BASE REPAIRS	0.	0.	0.	0.	0.	114328.	0.	0.	0.	0.
VALUE DEPOT REPA	68183.	96621.	74045.	94793.	87425.	95027.	230204.	158206.	179317.	195150.
ON ORDER ASSETS	0.	0.	74711.	80314.	99949.	108640.	102727.	187055.	211996.	230701.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	1496493.	1613857.	1698879.	1827189.	1955499.	2125543.	2354077.	2585218.	2930132.	3188818.
BUY OF 2-3 YR ITEMS	14015113.	14794006.	15600570.	16773494.	17946384.	19506928.	21455120.	23403312.	26524400.	28865264.
DPEM DOLLARS	13407.	32140.	25873.	32403.	33044.	35917.	92745.	64451.	73052.	79502.

Table 23j: Derivatives for End Item F100 with Respect to F015 Attrition, Percentage Loss/Sortie

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	-26666160.	-28147360.	-29628560.	-31848064.	-34067504.	-37029904.	-40735232.	-44440592.	-50365360.	-54808992.
SERVICEABLE ASSETS	-370606.	-291992.	-181524.	-169689.	-181609.	-3649.	-4014.	-4379.	-4963.	-5401.
BASE REPAIRS	0.	0.	0.	0.	0.	-193751.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	-115788.	-163802.	-125714.	-160742.	-147523.	-160351.	-389395.	-267988.	-303741.	-330556.
ON ORDER ASSETS	0.	0.	-125845.	-135283.	-169214.	-183928.	-173037.	-315080.	-357091.	-388599.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	-2526928.	-2724978.	-2868421.	-3083809.	-3299198.	-3586082.	-3973737.	-4365160.	-4947253.	-5383824.
BUY OF 2-3 YR ITEMS	-23652912.	-24966640.	-26327104.	-28298576.	-30270016.	-32902192.	-36195104.	-39488032.	-44752384.	-48700640.
DPEM DOLLARS	-22715.	-54314.	-43734.	-54753.	-55741.	-60588.	-156877.	-109196.	-123765.	-134691.

Table 23k: Derivatives for End Item F100 with Respect to F015 Sortie Length in Hours

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	33031808.	34867408.	36702992.	39460592.	42218240.	45889392.	50474048.	55058720.	62401072.	67907792.
SERVICEABLE ASSETS	458754.	361357.	224277.	209580.	224326.	4527.	4980.	5432.	6157.	6700.
BASE REPAIRS	0.	0.	0.	0.	0.	239305.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	142801.	202262.	155067.	198449.	182770.	198663.	481593.	331105.	375285.	408420.
ON ORDER ASSETS	0.	0.	156112.	167820.	209148.	227335.	214654.	390860.	442975.	482061.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	3129163.	3374526.	3552264.	3820113.	4087964.	4443437.	4921923.	5405630.	6126731.	6667560.
BUY OF 2-3 YR ITEMS	29301120.	30929312.	32615312.	35064704.	37514096.	40776192.	44850976.	48925776.	55450000.	60343120.
DPEM DOLLARS	28061.	67220.	54116.	67769.	69075.	75082.	194025.	134895.	152895.	166395.

Table 23m: Derivatives for End Item F100 with Respect to F015 Day RRR WRSK Repair Arrives

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	35334.	37413.	39491.	43648.	47805.	51962.	56119.	60276.	68590.	74826.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	175.	75.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	4809.	5203.	5492.	6070.	6648.	7226.	7804.	8382.	9538.	10405.
BUY OF 2-3 YR ITEMS	30350.	32136.	34000.	37579.	41158.	44737.	48315.	51894.	59052.	64421.
DPEM DOLLARS	36.	21.	0.	0.	0.	0.	0.	0.	0.	0.

Table 23n: Derivatives for End Item F100 with Respect to F015 Day WHSL Resupply Arrives

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	1557816.	1644393.	1730969.	1861126.	1991286.	2164439.	2380596.	2596747.	2943059.	3202794.
SERVICEABLE ASSETS	21868.	17217.	10653.	9948.	10650.	217.	238.	260.	295.	321.
BASE REPAIRS	0.	0.	0.	0.	0.	11359.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	6629.	9519.	7303.	9371.	8728.	9487.	22920.	15727.	17826.	19400.
ON ORDER ASSETS	0.	0.	7471.	8031.	9896.	10756.	10273.	18705.	21200.	23070.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	146726.	158232.	166568.	179139.	191711.	208382.	230706.	253382.	287186.	312540.
BUY OF 2-3 YR ITEMS	1382594.	1459428.	1538980.	1654642.	1770304.	1924242.	2116460.	2308677.	2616559.	2847467.
DPEM DOLLARS	1309.	3187.	2573.	3225.	3300.	3587.	9234.	6405.	7260.	7902.

Table 23o: Derivatives for End Item F100 with Respect to F016 Wartime Target Percentage Availability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	732048.	1084507.	1328537.	1518345.	1708124.	1925031.	2223292.	2494427.	2711331.	2819788.
SERVICEABLE ASSETS	19865.	1925.	2358.	2695.	3032.	3417.	3947.	4428.	4813.	5006.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	5526.	31001.	33693.	38506.	43319.	48820.	56384.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	63260.	68761.	71511.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	60899.	94910.	116266.	132876.	149485.	168467.	194569.	218297.	237279.	246770.
BUY OF 2-3 YR ITEMS	645758.	956672.	1176224.	1344271.	1512290.	1704330.	1968394.	2208443.	2400482.	2496503.
DPEM DOLLARS	1166.	12507.	14089.	16101.	18114.	20414.	23577.	0.	0.	0.

Table 23p: Derivatives for End Item F100 with Respect to F016 Wartime Target Percentage Probability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	123198.	182518.	223577.	255510.	287455.	323956.	374140.	419768.	456269.	474520.
SERVICEABLE ASSETS	780.	37.	46.	52.	59.	67.	77.	86.	94.	97.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	223.	1255.	1370.	1565.	1761.	1984.	2292.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	2571.	2795.	2907.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	6948.	10486.	12847.	14683.	16518.	18615.	21500.	24122.	26220.	27269.
BUY OF 2-3 YR ITEMS	115247.	170739.	209315.	239210.	269117.	303290.	350272.	392988.	427161.	444247.
DPEM DOLLARS	47.	507.	573.	654.	736.	830.	958.	0.	0.	0.

Table 23q: Derivatives for End Item F100 with Respect to F016 Sorties/Day Per Aircraft

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	7684563.	11384025.	13946872.	15940417.	17931968.	20209120.	23341248.	26187744.	28464912.	29603536.
SERVICEABLE ASSETS	126362.	95346.	71084.	71411.	80308.	9366.	10817.	12136.	13191.	13719.
BASE REPAIRS	0.	0.	0.	0.	0.	81144.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	33769.	116954.	119981.	147015.	155765.	175548.	296515.	121388.	131943.	137221.
ON ORDER ASSETS	0.	0.	45760.	52298.	68434.	77125.	76579.	283478.	308128.	320453.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	682211.	1035515.	1268694.	1450085.	1631215.	1838370.	2135846.	2410044.	2619613.	2724396.
BUY OF 2-3 YR ITEMS	6842225.	10136213.	12441353.	14219609.	15996258.	18027616.	20821536.	23360768.	25392096.	26407808.
DPEM DOLLARS	6759.	43876.	47047.	56758.	62730.	70696.	121366.	49453.	53753.	55903.

Table 23r: Derivatives for End Item F100 with Respect to F016 Attrition, Percentage Loss/Sortie

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	-12955373.	-19193472.	-23510992.	-26868928.	-30228192.	-34066640.	-39343792.	-44141856.	-47980256.	-49899504.
SERVICEABLE ASSETS	-213299.	-161114.	-120344.	-120946.	-136026.	-15779.	-18223.	-20445.	-22223.	-23112.
BASE REPAIRS	0.	0.	0.	0.	0.	-137525.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	-57155.	-197574.	-202756.	-248379.	-262639.	-295992.	-500743.	-205582.	-223459.	-232397.
ON ORDER ASSETS	0.	0.	-77080.	-88091.	-115868.	-130583.	-128991.	-477597.	-519128.	-539893.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	-1150522.	-1746400.	-2139426.	-2445124.	-2750706.	-3100011.	-3602192.	-4064832.	-4418298.	-4595027.
BUY OF 2-3 YR ITEMS	-11534400.	-17088400.	-20971424.	-23966448.	-26963040.	-30386800.	-35093712.	-39373456.	-42797232.	-44509120.
DPEM DOLLARS	-11418.	-74015.	-79367.	-95740.	-105754.	-119183.	-204949.	-83769.	-91054.	-94696.

Table 23s: Derivatives for End Item F100 with Respect to F016 Sortie Length in Hours

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	16061239.	23793696.	29149104.	33314704.	37477792.	42237056.	48782288.	54731344.	59490624.	61870256.
SERVICEABLE ASSETS	264197.	199409.	148747.	149447.	168070.	19571.	22603.	25360.	27565.	28668.
BASE REPAIRS	0.	0.	0.	0.	0.	169849.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	70657.	244582.	250937.	307456.	325572.	366919.	620033.	254035.	276125.	287170.
ON ORDER ASSETS	0.	0.	95618.	109278.	143205.	161392.	160015.	592376.	643887.	669643.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	1425999.	2164512.	2651842.	3030923.	3409573.	3842562.	4464538.	5037755.	5475824.	5694857.
BUY OF 2-3 YR ITEMS	14300389.	21185264.	26002032.	29717664.	33431440.	37676816.	43515136.	48821888.	53067280.	55189984.
DPEM DOLLARS	14135.	91719.	98349.	118646.	131109.	147758.	253782.	103499.	112499.	116998.

Table 23t: Derivatives for End Item F100 with Respect to F016 Day RRR WRSK Repair Arrives

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	9513.	13904.	17563.	20490.	22686.	25613.	30004.	33663.	36590.	38053.
SERVICEABLE ASSETS	60.	3.	4.	4.	5.	5.	6.	7.	8.	8.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	17.	96.	108.	126.	139.	157.	184.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	207.	224.	233.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	539.	802.	1013.	1182.	1309.	1478.	1731.	1942.	2111.	2196.
BUY OF 2-3 YR ITEMS	8897.	13003.	16438.	19178.	21233.	23973.	28082.	31507.	34247.	35616.
DPEM DOLLARS	4.	39.	45.	53.	58.	66.	77.	0.	0.	0.

Table 23u: Derivatives for End Item F100 with Respect to F016 Day WHSL Resupply Arrives

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	762106.	1129021.	1383115.	1580760.	1778306.	2004129.	2314685.	2596966.	2822788.	2935701.
SERVICEABLE ASSETS	12573.	9501.	7068.	7097.	7981.	933.	1078.	1209.	1314.	1367.
BASE REPAIRS	0.	0.	0.	0.	0.	8061.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	3336.	11583.	11870.	14555.	15479.	17445.	29454.	12069.	13118.	13643.
ON ORDER ASSETS	0.	0.	4576.	5230.	6774.	7635.	7658.	28220.	30674.	31901.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	67821.	102951.	126131.	144163.	162172.	182767.	212258.	239504.	260330.	270743.
BUY OF 2-3 YR ITEMS	678377.	1004988.	1233474.	1409717.	1585904.	1787892.	2064229.	2315966.	2517353.	2618048.
DPEM DOLLARS	670.	4356.	4668.	5534.	6233.	7025.	12059.	4916.	5343.	5557.

Table 24a: Derivatives for End Item J057 with Respect to J057 Peacetime Target Percentage Availability

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	541.	530.	520.	514.	504.	500.	500.	500.	500.	500.
SERVICEABLE ASSETS	2.	1.	1.	1.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	186.	181.	178.	140.	133.	122.	122.	122.	122.	121.
ON ORDER ASSETS	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	297.	292.	287.	319.	318.	325.	325.	325.	326.	326.
BUY OF 2-3 YR ITEMS	49.	49.	49.	48.	47.	47.	47.	47.	47.	47.
DPEM DOLLARS	58.	56.	55.	50.	49.	46.	46.	46.	46.	46.

Table 24b: Derivatives for End Item J057 with Respect to J057 Peacetime Target Percentage Probability

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	25686.	24414.	24930.	25641.	25842.	25746.	25742.	25736.	25767.	25767.
SERVICEABLE ASSETS	105.	25.	26.	26.	18.	18.	18.	18.	18.	3.
BASE REPAIRS	2.	15.	14.	14.	14.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	8833.	8361.	8518.	6994.	6809.	6290.	6289.	6280.	6274.	6253.
ON ORDER ASSETS	297.	283.	289.	297.	299.	298.	298.	298.	298.	298.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	14122.	13452.	13758.	15918.	16290.	16738.	16735.	16739.	16772.	16772.
BUY OF 2-3 YR ITEMS	2326.	2278.	2326.	2393.	2412.	2403.	2402.	2402.	2405.	2441.
DPEM DOLLARS	2734.	2592.	2635.	2499.	2505.	2368.	2368.	2366.	2367.	2349.

Table 24c: Derivatives for End Item J057 with Respect to J057 Deaccumulated OIM Program

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	34.	34.	34.	34.	34.	34.	34.	34.	34.	34.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	12.	13.	13.	10.	10.	9.	9.	9.	9.	9.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	19.	19.	19.	21.	21.	22.	22.	22.	22.	22.
BUY OF 2-3 YR ITEMS	2.	3.	3.	3.	3.	3.	3.	3.	3.	3.
DPEM DOLLARS	4.	4.	4.	4.	4.	4.	4.	4.	4.	4.

Table 24d: Derivatives for End Item J057 with Respect to J057 Accumulated OIM Program

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	159.	159.	159.	159.	159.	159.	159.	159.	159.	159.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	18.	19.	19.	19.	19.	19.	19.	19.	19.	19.
VALUE DEPOT REPAIRS	136.	136.	136.	136.	136.	136.	136.	136.	136.	136.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	4.	4.	4.	4.	4.	4.	4.	4.	4.	4.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	39.	39.	39.	38.	38.	38.	38.	38.	38.	38.

Table 24e: Derivatives for End Item J057 with Respect to J057 Deaccumulated EOH Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	4116.	4116.	4116.	4116.	4116.	4116.	4116.	4116.	4116.	4116.
SERVICEABLE ASSETS	32.	3.	3.	2.	2.	1.	1.	1.	1.	1.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	2365.	1958.	1957.	1295.	1267.	1034.	1034.	1030.	1027.	954.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	1428.	1792.	1793.	2455.	2483.	2717.	2717.	2721.	2724.	2730.
BUY OF 2-3 YR ITEMS	291.	363.	363.	363.	363.	363.	363.	363.	363.	431.
DPEM DOLLARS	614.	503.	502.	431.	430.	396.	395.	395.	394.	354.

Table 24f: Derivatives for End Item J057 with Respect to J057 Accumulated EOH Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	143454.	143454.	143454.	143454.	143454.	143454.	143454.	143454.	143454.	143454.
SERVICEABLE ASSETS	832.	72.	72.	53.	45.	36.	36.	36.	36.	36.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	131043.	128556.	128528.	127587.	126854.	126388.	126379.	126271.	126197.	125716.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	10638.	13241.	13270.	14229.	14969.	15444.	15454.	15562.	15636.	15800.
BUY OF 2-3 YR ITEMS	941.	1585.	1585.	1585.	1585.	1585.	1585.	1585.	1585.	1902.
DPEM DOLLARS	38458.	37581.	37564.	37434.	37402.	37287.	37285.	37266.	37256.	37062.

Table 24g: Derivatives for End Item J057 with Respect to B052 Wartime Target Percentage Availability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 24h: Derivatives for End Item J057 with Respect to B052 Wartime Target Percentage Probability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 24i: Derivatives for End Item J057 with Respect to B052 Sorties/Day Per Aircraft

DEPENDENT VARIABLE	FISCAL YEAR									
	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	1771047.	1644543.	1518040.	1433704.	1307202.	1265034.	1265034.	1265034.	1265034.	1265034.
SERVICEABLE ASSETS	2573.	2389.	2206.	2083.	1899.	1838.	1838.	1838.	1838.	1838.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	1768474.	1642154.	1515835.	1431622.	1305303.	1263196.	1263196.	1263196.	1263196.	1263196.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 24j: Derivatives for End Item J057 with Respect to B052 Attrition, Percentage Loss/Sortie

DEPENDENT VARIABLE	FISCAL YEAR									
	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	-281839.	-261707.	-241576.	-228155.	-208024.	-201313.	-201313.	-201313.	-201313.	-201313.
SERVICEABLE ASSETS	-427.	-397.	-366.	-346.	-315.	-305.	-305.	-305.	-305.	-305.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	-281411.	-261310.	-241210.	-227809.	-207708.	-201008.	-201008.	-201008.	-201008.	-201008.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 24k: Derivatives for End Item J057 with Respect to B052 Sortie Length in Hours

DEPENDENT VARIABLE	FISCAL YEAR									
	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	273138.	253628.	234118.	221112.	201602.	195098.	195098.	195098.	195098.	195098.
SERVICEABLE ASSETS	398.	370.	341.	322.	294.	284.	284.	284.	284.	284.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	272740.	253258.	233777.	220789	201308.	194814.	194814.	194814.	194814.	194814.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 24m: Derivatives for End Item J057 with Respect to B052 Day RRR WRSK Repair Arrives

DEPENDENT VARIABLE	FISCAL YEAR									
	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 24n: Derivatives for End Item J057 with Respect to B052 Day WHSL Resupply Arrives

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	58455.	54279.	50104.	47321.	43145.	41753.	41753.	41753.	41753.	41753.
SERVICEABLE ASSETS	80.	75.	69.	65.	59.	57.	57.	57.	57.	57.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	58374.	54205.	50035.	47256.	43086.	41696.	41696.	41696.	41696.	41696.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 24o: Derivatives for End Item J057 with Respect to C135 Wartime Target Percentage Availability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 24p: Derivatives for End Item J057 with Respect to C135 Wartime Target Percentage Probability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 24q: Derivatives for End Item J057 with Respect to C135 Sorties/Day Per Aircraft

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	3342762.	3313695.	3313695.	3313695.	3313695.	3313695.	3313695.	3313695.	3313695.	3313695.
SERVICEABLE ASSETS	4887.	4844.	4844.	4844.	4844.	4844.	4844.	4844.	4844.	4844.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	3337876.	3308851.	3308851.	3308851.	3308851.	3308851.	3308851.	3308851.	3308851.	3308851.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 24r: Derivatives for End Item J057 with Respect to C135 Attrition, Percentage Loss/Sortie

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	-505413.	-501018.	-501018.	-501018.	-501018.	-501018.	-501018.	-501018.	-501018.	-501018.
SERVICEABLE ASSETS	-769.	-762.	-762.	-762.	-762.	-762.	-762.	-762.	-762.	-762.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	-504644.	-500256.	-500256.	-500256.	-500256.	-500256.	-500256.	-500256.	-500256.	-500256.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 24s: Derivatives for End Item J057 with Respect to C135 Sortie Length in Hours

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	477538.	473385.	473385.	473385.	473385.	473385.	473385.	473385.	473385.	473385.
SERVICEABLE ASSETS	698.	692.	692.	692.	692.	692.	692.	692.	692.	692.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	476840.	472693.	472693.	472693.	472693.	472693.	472693.	472693.	472693.	472693.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 24t: Derivatives for End Item J057 with Respect to C135 Day RRR WRSK Repair Arrives

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 24u: Derivatives for End Item J057 with Respect to C135 Day WHSL Resupply Arrives

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	110359.	109399.	109399.	109399.	109399.	109399.	109399.	109399.	109399.	109399.
SERVICEABLE ASSETS	153.	152.	152.	152.	152.	152.	152.	152.	152.	152.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	110206.	109248.	109248.	109248.	109248.	109248.	109248.	109248.	109248.	109248.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 25a: Derivatives for End Item J079 with Respect to J079 Peacetime Target Percentage Availability

	FISCAL YEAR									
DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	452.	443.	440.	436.	431.	429.	431.	433.	433.	433.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	287.	237.	235.	230.	228.	226.	215.	216.	215.	215.
ON ORDER ASSETS	51.	94.	78.	53.	24.	15.	13.	13.	13.	13.
BUY OF 0-1 YR ITEMS	9.	9.	9.	9.	9.	9.	9.	9.	9.	9.
BUY OF 1-2 YR ITEMS	83.	83.	82.	83.	82.	83.	83.	84.	84.	84.
BUY OF 2-3 YR ITEMS	20.	20.	35.	60.	88.	96.	111.	111.	111.	111.
DPEM DOLLARS	36.	32.	31.	30.	30.	29.	29.	29.	28.	28.

Table 25b: Derivatives for End Item J079 with Respect to J079 Peacetime Target Percentage Probability

	FISCAL YEAR									
DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	18863.	19365.	19699.	19933.	19417.	18945.	18152.	17639.	16905.	16905.
SERVICEABLE ASSETS	12.	12.	12.	12.	12.	12.	11.	11.	11.	11.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	11991.	10352.	10525.	10524.	10251.	10000.	9040.	8779.	8386.	8380.
ON ORDER ASSETS	2132.	4112.	3495.	2441.	1094.	651.	545.	529.	507.	513.
BUY OF 0-1 YR ITEMS	387.	397.	404.	409.	398.	394.	377.	373.	357.	357.
BUY OF 1-2 YR ITEMS	3487.	3615.	3677.	3803.	3704.	3661.	3508.	3409.	3296.	3296.
BUY OF 2-3 YR ITEMS	854.	877.	1586.	2744.	3957.	4227.	4669.	4537.	4349.	4349.
DPEM DOLLARS	1509.	1380.	1404.	1371.	1335.	1302.	1200.	1165.	1097.	1091.

Table 25c: Derivatives for End Item J079 with Respect to J079 Deaccumulated OIM Program

	FISCAL YEAR									
DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	32.	32.	32.	32.	32.	32.	32.	32.	33.	33.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	17.	12.	12.	11.	11.	12.	11.	11.	11.	11.
ON ORDER ASSETS	5.	10.	9.	7.	3.	1.	1.	1.	1.	1.
BUY OF 0-1 YR ITEMS	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
BUY OF 1-2 YR ITEMS	6.	6.	6.	7.	7.	7.	7.	7.	7.	7.
BUY OF 2-3 YR ITEMS	3.	3.	4.	6.	10.	12.	13.	13.	13.	13.
DPEM DOLLARS	2.	2.	2.	2.	2.	2.	2.	2.	1.	1.

Table 25d: Derivatives for End Item J079 with Respect to J079 Accumulated OIM Program

	FISCAL YEAR									
DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	196.	196.	196.	196.	196.	196.	196.	196.	196.	196.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	30.	30.	30.	30.	30.	30.	30.	30.	30.	30.
VALUE DEPOT REPAIRS	154.	151.	151.	151.	151.	151.	151.	151.	151.	151.
ON ORDER ASSETS	9.	12.	9.	9.	2.	2.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	1.	1.	1.	2.	2.	2.	2.	2.	2.	2.
BUY OF 2-3 YR ITEMS	2.	2.	4.	5.	11.	12.	13.	13.	13.	13.
DPEM DOLLARS	19.	19.	19.	18.	18.	18.	18.	18.	18.	18.

Table 25e: Derivatives for End Item J079 with Respect to J079 Deaccumulated EOH Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	1826.	1826.	1826.	1826.	1826.	1826.	1826.	1826.	1826.	1826.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	209.	79.	79.	39.	39.	39.	0.	0.	0.	0.
ON ORDER ASSETS	58.	188.	188.	139.	82.	0.	39.	39.	39.	39.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	1402.	1402.	1402.	1441.	1441.	1441.	1441.	1441.	1441.	1441.
BUY OF 2-3 YR ITEMS	157.	157.	157.	206.	264.	346.	346.	346.	346.	346.
DPEM DOLLARS	41.	29.	29.	3.	3.	3.	0.	0.	0.	0.

Table 25f: Derivatives for End Item J079 with Respect to J079 Accumulated EOH Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	446100.	446100.	446100.	446100.	446100.	446100.	446100.	446100.	446100.	446100.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	436322.	429132.	428662.	426301.	426271.	426263.	425237.	425206.	425206.	425157.
ON ORDER ASSETS	5423.	12529.	5169.	5123.	3653.	179.	1176.	1176.	1041.	1089.
BUY OF 0-1 YR ITEMS	86.	86.	86.	86.	86.	94.	94.	126.	126.	126.
BUY OF 1-2 YR ITEMS	166.	251.	360.	1490.	1490.	2829.	2858.	2858.	2993.	2993.
BUY OF 2-3 YR ITEMS	4103.	4103.	11823.	13100.	14600.	16735.	16735.	16735.	16735.	16735.
DPEM DOLLARS	50148.	49786.	49764.	49089.	49084.	49080.	48990.	48986.	48986.	48934.

Table 25g: Derivatives for End Item J079 with Respect to F004 Wartime Target Percentage Availability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	160601.	154303.	152727.	149578.	146429.	144853.	146429.	148005.	148005.	148005.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	8202.	7879.	7812.	7651.	7489.	7422.	7489.	7556.	7556.	7556.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	152399.	146424.	144915.	141927.	138940.	137431.	138940.	140449.	140449.	140449.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	4145.	3981.	3950.	3868.	3786.	3755.	3786.	3818.	3818.	3818.

Table 25h: Derivatives for End Item J079 with Respect to F004 Wartime Target Percentage Probability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	10618.	10201.	10097.	9889.	9681.	9577.	9681.	9785.	9785.	9785.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	175.	168.	167.	163.	160.	158.	160.	161.	161.	161.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	10443.	10033.	9931.	9726.	9521.	9418.	9521.	9624.	9624.	9624.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	88.	84.	83.	82.	80.	79.	80.	81.	81.	81.

Table 25i: Derivatives for End Item J079 with Respect to F004 Sorties/Day Per Aircraft

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	5548774.	5330976.	5279052.	5170151.	5061253.	5009324.	5061253.	5113181.	5113181.	5113181.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	888254.	853388.	845092.	827659.	810225.	801929.	810225.	818522.	764738.	759001.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	5737.
BUY OF 0-1 YR ITEMS	377214.	362407.	358886.	351482.	344079.	340558.	344079.	347600.	347600.	347600.
BUY OF 1-2 YR ITEMS	3348074.	3216704.	3184785.	3119101.	3053414.	3021495.	3053414.	3085335.	3139118.	3139118.
BUY OF 2-3 YR ITEMS	935238.	898484.	890294.	871917.	853540.	845350.	853540.	861730.	861730.	861730.
DPEM DOLLARS	181509.	174383.	172697.	169135.	165572.	163886.	165572.	167258.	128874.	122625.

Table 25j: Derivatives for End Item J079 with Respect to F004 Attrition, Percentage Loss/Sortie

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	-5247310.	-5041396.	-4991668.	-4888710.	-4785756.	-4736025.	-4785756.	-4835482.	-4835482.	-4835482.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	-841862.	-808823.	-800873.	-784354.	-767835.	-759884.	-767835.	-775785.	-725131.	-719651.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	-5480.
BUY OF 0-1 YR ITEMS	-357559.	-343527.	-340153.	-333137.	-326121.	-322747.	-326121.	-329494.	-329494.	-329494.
BUY OF 1-2 YR ITEMS	-3155438.	-3031655.	-3001221.	-2939331.	-2877439.	-2847008.	-2877439.	-2907871.	-2958524.	-2958524.
BUY OF 2-3 YR ITEMS	-892459.	-857399.	-849427.	-831897.	-814366.	-806395.	-814366.	-822338.	-822338.	-822338.
DPEM DOLLARS	-171709.	-164970.	-163359.	-159989.	-156619.	-155008.	-156619.	-158230.	-122080.	-116111.

Table 25k: Derivatives for End Item J079 with Respect to F004 Sortie Length in Hours

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	8217648.	7895110.	7817991.	7656724.	7495453.	7418334.	7495453.	7572574.	7572574.	7572574.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	1316140.	1264481.	1252157.	1226328.	1200499.	1188175.	1200499.	1212820.	1133241.	1124725.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	8516.
BUY OF 0-1 YR ITEMS	558941.	537002.	531772.	520802.	509833.	504603.	509833.	515063.	515063.	515063.
BUY OF 1-2 YR ITEMS	4954686.	4760288.	4712930.	4615730.	4518529.	4471170.	4518529.	4565889.	4645468.	4645468.
BUY OF 2-3 YR ITEMS	1387883.	1333344.	1321136.	1293866.	1266597.	1254389.	1266597.	1278806.	1278806.	1278806.
DPEM DOLLARS	268833.	258280.	255777.	250501.	245224.	242722.	245224.	247727.	190933.	181657.

Table 25m: Derivatives for End Item J079 with Respect to F004 Day RRR WRSK Repair Arrives

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	4617.	4432.	4432.	4340.	4247.	4247.	4247.	4247.	4247.	4247.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	88.	84.	84.	82.	81.	81.	81.	81.	81.	81.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	4529.	4348.	4348.	4257.	4167.	4167.	4167.	4167.	4167.	4167.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	46.	44.	44.	43.	42.	42.	42.	42.	42.	42.

Table 25n: Derivatives for End Item J079 with Respect to F004 Day WHSL Resupply Arrives

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	418403.	401977.	398102.	389889.	381676.	377801.	381676.	385551.	385551.	385551.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	67271.	64630.	64010.	62689.	61368.	60748.	61368.	61989.	57884.	57452.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	432.
BUY OF 0-1 YR ITEMS	28602.	27479.	27215.	26654.	26093.	25829.	26093.	26356.	26356.	26356.
BUY OF 1-2 YR ITEMS	252053.	242162.	239776.	234831.	229885.	227499.	229885.	232271.	236376.	236376.
BUY OF 2-3 YR ITEMS	70476.	67706.	67101.	65716.	64331.	63726.	64331.	64935.	64935.	64935.
DPEM DOLLARS	13758.	13218.	13091.	12821.	12551.	12425.	12551.	12678.	9748.	9277.

Table 26a: Derivatives for End Item TF033 with Respect to TF033 Peacetime Target Percentage Availability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	3023.	2970.	2916.	2880.	2824.	2805.	2805.	2805.	2805.	2805.
SERVICEABLE ASSETS	6.	3.	3.	2.	1.	1.	1.	1.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	561.	550.	527.	381.	372.	360.	359.	358.	356.	355.
ON ORDER ASSETS	120.	86.	82.	197.	151.	30.	30.	21.	23.	23.
BUY OF 0-1 YR ITEMS	7.	7.	7.	7.	6.	6.	6.	6.	6.	6.
BUY OF 1-2 YR ITEMS	294.	294.	301.	300.	297.	301.	302.	304.	305.	307.
BUY OF 2-3 YR ITEMS	2035.	2030.	1997.	1993.	1997.	2106.	2106.	2114.	2114.	2114.
OPEM DOLLARS	46.	45.	43.	33.	32.	30.	30.	30.	30.	30.

Table 26b: Derivatives for End Item TF033 with Respect to TF033 Peacetime Target Percentage Probability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	47190.	47071.	48340.	48501.	48142.	48180.	48180.	48180.	48180.	48180.
SERVICEABLE ASSETS	98.	50.	45.	30.	22.	18.	18.	17.	6.	5.
BASE REPAIRS	0.	5.	0.	0.	0.	0.	0.	0.	0.	1.
VALUE DEPOT REPAIRS	8756.	8711.	8732.	6417.	6333.	6187.	6172.	6155.	6115.	6089.
ON ORDER ASSETS	1876.	1363.	1362.	3317.	2566.	512.	515.	366.	403.	403.
BUY OF 0-1 YR ITEMS	107.	107.	110.	110.	109.	109.	109.	109.	109.	109.
BUY OF 1-2 YR ITEMS	4583.	4659.	4996.	5056.	5063.	5177.	5190.	5229.	5242.	5268.
BUY OF 2-3 YR ITEMS	31772.	32177.	33096.	33572.	34049.	36177.	36177.	36304.	36304.	36304.
OPEM DOLLARS	721.	713.	714.	550.	538.	523.	520.	518.	516.	514.

Table 26c: Derivatives for End Item TF033 with Respect to TF033 Deaccumulated OIM Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	35.	35.	35.	35.	35.	35.	35.	35.	35.	35.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	7.	7.	6.	4.	4.	4.	4.	4.	4.	4.
ON ORDER ASSETS	1.	1.	1.	3.	2.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	5.	5.	5.	5.	5.	6.	6.	6.	6.	6.
BUY OF 2-3 YR ITEMS	21.	22.	22.	22.	23.	24.	24.	25.	25.	25.
OPEM DOLLARS	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.

Table 26d: Derivatives for End Item TF033 with Respect to TF033 Accumulated OIM Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	233.	233.	233.	233.	233.	233.	233.	233.	233.	233.
SERVICEABLE ASSETS	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	73.	73.	73.	73.	73.	73.	73.	73.	73.	73.
VALUE DEPOT REPAIRS	156.	157.	157.	156.	156.	156.	156.	156.	156.	156.
ON ORDER ASSETS	1.	1.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
BUY OF 2-3 YR ITEMS	1.	1.	1.	2.	2.	2.	2.	2.	2.	2.
OPEM DOLLARS	14.	14.	14.	14.	14.	14.	14.	14.	14.	14.

Table 26e: Derivatives for End Item TF033 with Respect to TF033 Deaccumulated EOH Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	4248.	4248.	4248.	4248.	4248.	4248.	4248.	4248.	4248.	4248.
SERVICEABLE ASSETS	580.	80.	73.	61.	51.	16.	16.	14.	9.	9.
BASE REPAIRS	0.	1.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	2580.	2935.	2880.	2213.	2176.	1541.	1456.	1290.	1221.	985.
ON ORDER ASSETS	461.	258.	218.	829.	445.	292.	292.	37.	37.	37.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	370.	496.	564.	610.	657.	1213.	1297.	1449.	1524.	1760.
BUY OF 2-3 YR ITEMS	258.	479.	513.	536.	920.	1188.	1188.	1458.	1458.	1458.
DPEM DOLLARS	511.	550.	541.	337.	331.	244.	230.	205.	195.	166.

Table 26f: Derivatives for End Item TF033 with Respect to TF033 Accumulated EOH Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	1470576.	1470576.	1470576.	1470576.	1470576.	1470576.	1470576.	1470576.	1470576.	1470576.
SERVICEABLE ASSETS	18905.	2185.	2010.	1687.	1420.	440.	440.	402.	252.	252.
BASE REPAIRS	0.	29.	0.	0.	0.	6.	6.	6.	6.	6.
VALUE DEPOT REPAIRS	1413381.	1428793.	1425918.	1421236.	1420660.	1418320.	1417721.	1416560.	1415940.	1414300.
ON ORDER ASSETS	14646.	10210.	9460.	9810.	3098.	1734.	1753.	914.	1093.	1093.
BUY OF 0-1 YR ITEMS	160.	160.	160.	160.	160.	160.	160.	160.	160.	160.
BUY OF 1-2 YR ITEMS	6472.	7725.	9990.	11576.	12419.	14936.	15516.	16639.	17228.	18868.
BUY OF 2-3 YR ITEMS	17019.	21476.	23042.	26110.	32821.	34982.	34982.	35898.	35898.	35898.
DPEM DOLLARS	108608.	110445.	110073.	109210.	109098.	108863.	108767.	108592.	108528.	108322.

Table 26g: Derivatives for End Item TF033 with Respect to B052 Wartime Target Percentage Availability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	466.	433.	400.	378.	344.	333.	333.	333.	333.	333.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	466.	433.	400.	378.	344.	333.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	333.	333.	333.	333.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	45.	42.	39.	36.	33.	32.	0.	0.	0.	0.

Table 26h: Derivatives for End Item TF033 with Respect to B052 Wartime Target Percentage Probability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	28.	26.	24.	23.	21.	20.	20.	20.	20.	20.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	28.	26.	24.	23.	21.	20.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	20.	20.	20.	20.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	3.	3.	2.	2.	2.	2.	0.	0.	0.	0.

Table 26i: Derivatives for End Item TF033 with Respect to B052 Sorties/Day Per Aircraft

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	7617458.	7073350.	6529246.	6166511.	5622401.	5441032.	5441032.	5441032.	5441032.	5441032.
SERVICEABLE ASSETS	68985.	13395.	10852.	7242.	4289.	4150.	4150.	4150.	406.	406.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	290442.	319559.	277031.	172994.	160044.	132687.	126008.	113514.	89806.	63993.
ON ORDER ASSETS	103729.	14626.	21780.	22887.	20867.	11318.	17997.	14208.	32991.	32991.
BUY OF 0-1 YR ITEMS	118157.	109717.	101277.	95651.	87211.	84398.	84398.	84398.	84398.	84398.
BUY OF 1-2 YR ITEMS	2308866.	2144644.	1983013.	1872846.	1707595.	1667655.	1667655.	1683937.	1692607.	1718420.
BUY OF 2-3 YR ITEMS	4727300.	4471329.	4135314.	3994910.	3642416.	3540844.	3540844.	3540844.	3540844.	3540844.
OPEM DOLLARS	48802.	51960.	46085.	22149.	20417.	18038.	17394.	15544.	13817.	10792.

Table 26j: Derivatives for End Item TF033 with Respect to B052 Attrition, Percentage Loss/Sortie

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	-1229520.	-1141699.	-1053882.	-995334.	-907511.	-878236.	-878236.	-878236.	-878236.	-878236.
SERVICEABLE ASSETS	-10987.	-2135.	-1731.	-1161.	-686.	-664.	-664.	-664.	-65.	-65.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	-47806.	-52348.	-45351.	-28224.	-26106.	-21579.	-20468.	-18463.	-14467.	-10322.
ON ORDER ASSETS	-16438.	-2353.	-3546.	-3704.	-3377.	-1849.	-2960.	-2323.	-5546.	-5546.
BUY OF 0-1 YR ITEMS	-19148.	-17780.	-16412.	-15501.	-14133.	-13677.	-13677.	-13677.	-13677.	-13677.
BUY OF 1-2 YR ITEMS	-369649.	-343355.	-317475.	-299838.	-273382.	-266986.	-266986.	-269628.	-271001.	-275146.
BUY OF 2-3 YR ITEMS	-765505.	-723737.	-669369.	-646908.	-589828.	-573481.	-573481.	-573481.	-573481.	-573481.
OPEM DOLLARS	-7864.	-8363.	-7412.	-3583.	-3302.	-2912.	-2805.	-2508.	-2226.	-1745.

Table 26k: Derivatives for End Item TF033 with Respect to B052 Sortie Length in Hours

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	1176023.	1092027.	1008029.	952027.	868024.	840024.	840024.	840024.	840024.	840024.
SERVICEABLE ASSETS	10640.	2066.	1674.	1117.	662.	640.	640.	640.	63.	63.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	44907.	49405.	42815.	26729.	24728.	20497.	19463.	17535.	13863.	9879.
ON ORDER ASSETS	15993.	2257.	3365.	3534.	3222.	1749.	2782.	2196.	5109.	5109.
BUY OF 0-1 YR ITEMS	18247.	16944.	15640.	14772.	13468.	13034.	13034.	13034.	13034.	13034.
BUY OF 1-2 YR ITEMS	356242.	330904.	305965.	288967.	263469.	257307.	257307.	259822.	261158.	265142.
BUY OF 2-3 YR ITEMS	730007.	690457.	638571.	616909.	562476.	546798.	546798.	546798.	546798.	546798.
OPEM DOLLARS	7533.	8020.	7113.	3420.	3153.	2785.	2685.	2400.	2133.	1666.

Table 26m: Derivatives for End Item TF033 with Respect to B052 Day RRR WRSK Repair Arrives

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 26n: Derivatives for End Item TF033 with Respect to B052 Day WHSL Resupply Arrives

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	247003.	229360.	211717.	199955.	182312.	176431.	176431.	176431.	176431.	176431.
SERVICEABLE ASSETS	2274.	440.	356.	236.	140.	135.	135.	135.	13.	13.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	9224.	10213.	8855.	5549.	5134.	4269.	4060.	3652.	2920.	2076.
ON ORDER ASSETS	3440.	477.	701.	741.	676.	363.	572.	454.	1020.	1020.
BUY OF 0-1 YR ITEMS	3806.	3535.	3263.	3081.	2809.	2719.	2719.	2719.	2719.	2719.
BUY OF 1-2 YR ITEMS	75621.	70243.	64950.	61341.	55929.	54621.	54621.	55147.	55435.	56279.
BUY OF 2-3 YR ITEMS	152639.	144454.	133595.	129008.	117625.	114325.	114325.	114325.	114325.	114325.
DPEM DOLLARS	1588.	1693.	1503.	717.	661.	585.	565.	505.	449.	349.

Table 26o: Derivatives for End Item TF033 with Respect to C141 Wartime Target Percentage Availability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	575.	575.	575.	575.	575.	575.	575.	575.	575.	575.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	575.	575.	575.	575.	575.	575.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	575.	575.	575.	575.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	55.	55.	55.	55.	55.	55.	0.	0.	0.	0.

Table 26p: Derivatives for End Item TF033 with Respect to C141 Wartime Target Percentage Probability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	63.	63.	63.	63.	63.	63.	63.	63.	63.	63.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	63.	63.	63.	63.	63.	63.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	63.	63.	63.	63.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	6.	6.	6.	6.	6.	6.	0.	0.	0.	0.

Table 26q: Derivatives for End Item TF033 with Respect to C141 Sorties/Day Per Aircraft

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	17389376.	17389376.	17389376.	17389376.	17389376.	17389376.	17389376.	17389376.	17389376.	17389376.
SERVICEABLE ASSETS	157235.	32884.	28865.	20409.	13253.	13253.	13253.	13253.	1295.	1295.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	658933.	781571.	733369.	482538.	489694.	418440.	403236.	363323.	287040.	204573.
ON ORDER ASSETS	236258.	35952.	58102.	64590.	64590.	36249.	51453.	39267.	99867.	99867.
BUY OF 0-1 YR ITEMS	269985.	269985.	269985.	269985.	269985.	269985.	269985.	269985.	269985.	269985.
BUY OF 1-2 YR ITEMS	5266483.	5268196.	5277075.	5277075.	5277075.	5325432.	5325432.	5377528.	5405169.	5487635.
BUY OF 2-3 YR ITEMS	10800628.	11000934.	11022124.	11274923.	11274923.	11326160.	11326160.	11326160.	11326160.	11326160.
DPEM DOLLARS	110817.	127131.	122119.	61900.	62587.	57069.	55602.	49693.	44164.	34514.

Table 26r: Derivatives for End Item TF033 with Respect to C141 Attrition, Percentage Loss/Sortie

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	-2664088.	-2664088.	-2664088.	-2664088.	-2664088.	-2664088.	-2664088.	-2664088.	-2664088.	-2664088.
SERVICEABLE ASSETS	-23792.	-4979.	-4374.	-3106.	-2014.	-2014.	-2014.	-2014.	-196.	-196.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	-102825.	-121380.	-113856.	-74673.	-75764.	-64555.	-62147.	-56065.	-43897.	-31320.
ON ORDER ASSETS	-35582.	-5491.	-8976.	-9922.	-9922.	-5618.	-8026.	-6086.	-15914.	-15914.
BUY OF 0-1 YR ITEMS	-41512.	-41512.	-41512.	-41512.	-41512.	-41512.	-41512.	-41512.	-41512.	-41512.
BUY OF 1-2 YR ITEMS	-800749.	-801005.	-802349.	-802349.	-802349.	-809699.	-809699.	-817721.	-821879.	-834456.
BUY OF 2-3 YR ITEMS	-1659649.	-1689740.	-1693041.	-1732545.	-1732545.	-1740709.	-1740709.	-1740709.	-1740709.	-1740709.
DPEM DOLLARS	-16950.	-19425.	-18648.	-9502.	-9606.	-8743.	-8511.	-7611.	-6755.	-5298.

Table 26s: Derivatives for End Item TF033 with Respect to C141 Sortie Length in Hours

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	1449114.	1449114.	1449114.	1449114.	1449114.	1449114.	1449114.	1449114.	1449114.	1449114.
SERVICEABLE ASSETS	13103.	2740.	2405.	1701.	1104.	1104.	1104.	1104.	108.	108.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	54911.	65131.	61114.	40212.	40808.	34870.	33603.	30277.	23920.	17048.
ON ORDER ASSETS	19688.	2996.	4842.	5382.	5382.	3021.	4288.	3272.	8322.	8322.
BUY OF 0-1 YR ITEMS	22499.	22499.	22499.	22499.	22499.	22499.	22499.	22499.	22499.	22499.
BUY OF 1-2 YR ITEMS	438874.	439017.	439757.	439757.	439757.	443786.	443786.	448128.	450431.	457303.
BUY OF 2-3 YR ITEMS	900053.	916745.	918511.	939577.	939577.	943847.	943847.	943847.	943847.	943847.
DPEM DOLLARS	9235.	10594.	10177.	5158.	5216.	4756.	4633.	4141.	3680.	2876.

Table 26t: Derivatives for End Item TF033 with Respect to C141 Day RRR WRSK Repair Arrives

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 26u: Derivatives for End Item TF033 with Respect to C141 Day WHSL Resupply Arrives

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	564369.	564369.	564369.	564369.	564369.	564369.	564369.	564369.	564369.	564369.
SERVICEABLE ASSETS	5184.	1081.	947.	666.	432.	432.	432.	432.	43.	43.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	20951.	24997.	23465.	15493.	15727.	13477.	13004.	11699.	9339.	6643.
ON ORDER ASSETS	7837.	1173.	1871.	2093.	2093.	1163.	1635.	1257.	3088.	3088.
BUY OF 0-1 YR ITEMS	8709.	8709.	8709.	8709.	8709.	8709.	8709.	8709.	8709.	8709.
BUY OF 1-2 YR ITEMS	172583.	172640.	172933.	172933.	172933.	174519.	174519.	176203.	177122.	179818.
BUY OF 2-3 YR ITEMS	349106.	355771.	356445.	364476.	364476.	366070.	366070.	366070.	366070.	366070.
DPEM DOLLARS	3608.	4145.	3984.	2006.	2028.	1853.	1808.	1614.	1437.	1118.

Table 27a: Derivatives for End Item TF039 with Respect to TF039 Peacetime Target Percentage Availability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	918.	918.	921.	982.	1045.	1106.	1224.	1264.	1264.	1264.
SERVICEABLE ASSETS	3.	2.	2.	3.	3.	3.	3.	3.	3.	3.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	5.	5.	5.	5.	1.	1.	1.	1.	1.	1.
ON ORDER ASSETS	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	12.	13.	13.	14.	19.	20.	23.	23.	23.	23.
BUY OF 2-3 YR ITEMS	897.	897.	900.	960.	1022.	1081.	1196.	1235.	1235.	1235.
OPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 27b: Derivatives for End Item TF039 with Respect to TF039 Peacetime Target Percentage Probability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	57114.	57621.	61409.	63121.	70987.	76043.	83764.	81852.	81852.	81852.
SERVICEABLE ASSETS	158.	156.	166.	171.	191.	202.	223.	218.	218.	218.
BASE REPAIRS	0.	0.	0.	0.	0.	1.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	303.	309.	330.	336.	68.	75.	66.	65.	63.	63.
ON ORDER ASSETS	64.	55.	58.	47.	53.	57.	63.	52.	52.	52.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	774.	791.	844.	869.	1292.	1387.	1553.	1515.	1518.	1518.
BUY OF 2-3 YR ITEMS	55815.	56311.	60011.	61699.	69384.	74322.	81860.	80002.	80002.	80002.
OPEM DOLLARS	24.	24.	26.	27.	13.	14.	9.	9.	8.	8.

Table 27c: Derivatives for End Item TF039 with Respect to TF039 Deaccumulated OIM Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	101.	100.	98.	98.	95.	93.	91.	91.	91.	91.
SERVICEABLE ASSETS	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	3.	3.	3.	3.	1.	1.	0.	0.	0.	0.
ON ORDER ASSETS	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	4.	4.	4.	4.	6.	6.	6.	6.	6.	6.
BUY OF 2-3 YR ITEMS	90.	90.	88.	88.	85.	84.	82.	82.	82.	82.
OPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 27d: Derivatives for End Item TF039 with Respect to TF039 Accumulated OIM Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	509.	509.	509.	509.	509.	509.	509.	509.	509.	509.
SERVICEABLE ASSETS	12.	12.	12.	12.	12.	11.	11.	11.	11.	11.
BASE REPAIRS	91.	91.	91.	91.	91.	91.	91.	91.	91.	91.
VALUE DEPOT REPAIRS	404.	404.	404.	404.	404.	404.	404.	404.	404.	404.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	0.	0.	0.	0.	1.	1.	1.	1.	1.	1.
BUY OF 2-3 YR ITEMS	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
OPEM DOLLARS	16.	16.	16.	16.	16.	16.	16.	16.	16.	16.

Table 27e: Derivatives for End Item TF039 with Respect to TF039 Deaccumulated EOH Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	100575.	100575.	100575.	100575.	100575.	100575.	100575.	100575.	100575.	100575.
SERVICEABLE ASSETS	293.	226.	116.	111.	94.	11.	11.	5.	5.	5.
BASE REPAIRS	0.	0.	7.	0.	0.	24.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	1561.	1628.	1731.	1627.	1271.	1284.	1308.	1314.	1287.	1287.
ON ORDER ASSETS	990.	965.	965.	855.	855.	855.	855.	823.	823.	823.
BUY OF 0-1 YR ITEMS	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.
BUY OF 1-2 YR ITEMS	3471.	3496.	3496.	3517.	3873.	3873.	3873.	3873.	3900.	3900.
BUY OF 2-3 YR ITEMS	94246.	94246.	94246.	94452.	94470.	94515.	94515.	94546.	94546.	94546.
DPEM DOLLARS	113.	117.	120.	117.	98.	98.	99.	101.	95.	95.

Table 27f: Derivatives for End Item TF039 with Respect to TF039 Accumulated EOH Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	2675034.	2675034.	2675034.	2675034.	2675034.	2675034.	2675034.	2675034.	2675034.	2675034.
SERVICEABLE ASSETS	7635.	5901.	3017.	2896.	2440.	293.	293.	129.	129.	129.
BASE REPAIRS	0.	0.	186.	1.	0.	624.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	2614618.	2616351.	2619050.	2619309.	2619605.	2619962.	2620586.	2620750.	2620728.	2620728.
ON ORDER ASSETS	2561.	1912.	1912.	1681.	1681.	1681.	1681.	858.	858.	858.
BUY OF 0-1 YR ITEMS	380.	380.	380.	380.	380.	380.	380.	380.	380.	380.
BUY OF 1-2 YR ITEMS	3148.	3798.	3798.	3820.	3912.	3912.	3912.	3912.	3934.	3934.
BUY OF 2-3 YR ITEMS	46701.	46701.	46701.	46956.	47022.	48188.	48188.	49011.	49011.	49011.
DPEM DOLLARS	88579.	88692.	88759.	88775.	88809.	88828.	88852.	88894.	88890.	88890.

Table 27g: Derivatives for End Item TF039 with Respect to C005 Wartime Target Percentage Availability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 27h: Derivatives for End Item TF039 with Respect to C005 Wartime Target Percentage Probability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 27i: Derivatives for End Item TF039 with Respect to C005 Sorties/Day Per Aircraft

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
	FISCAL YEAR									
TOTAL GROSS RQMTS	43477792.	43477792.	43477792.	48912528.	54347280.	59782032.	70651648.	76086352.	76086352.	76086352.
SERVICEABLE ASSETS	1122872.	1117485.	1115238.	1254645.	1390628.	1518061.	1794072.	1931742.	1931742.	1931742.
BASE REPAIRS	0.	0.	0.	0.	0.	4969.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	1431495.	1436881.	1439128.	1599147.	212616.	240540.	222458.	239907.	235124.	235124.
ON ORDER ASSETS	166507.	143578.	143578.	161526.	179473.	197420.	233315.	238250.	238250.	238250.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	1825208.	1848136.	1848136.	2081149.	3880024.	4268027.	5111719.	5504929.	5509712.	5509712.
BUY OF 2-3 YR ITEMS	38931856.	38931856.	38931856.	43816240.	48684688.	53553200.	63290176.	68171648.	68171648.	68171648.
DPEM DOLLARS	105174.	105411.	105548.	118183.	43447.	48132.	32646.	35245.	34183.	34183.

Table 27j: Derivatives for End Item TF039 with Respect to C005 Attrition, Percentage Loss/Sortie

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
	FISCAL YEAR									
TOTAL GROSS RQMTS	-6733196.	-6733196.	-6733196.	-7574847.	-8416498.	-9258150.	-10941448.	-11783102.	-11783102.	-11783102.
SERVICEABLE ASSETS	-170915.	-170077.	-169736.	-190953.	-211650.	-230812.	-272778.	-293704.	-293704.	-293704.
BASE REPAIRS	0.	0.	0.	0.	0.	-1002.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	-215901.	-216739.	-217080.	-240663.	-32199.	-36420.	-33986.	-36658.	-35933.	-35933.
ON ORDER ASSETS	-26234.	-22664.	-22664.	-25497.	-28330.	-31163.	-36829.	-37700.	-37700.	-37700.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	-275931.	-279501.	-279501.	-314749.	-585446.	-643990.	-771319.	-830651.	-831375.	-831375.
BUY OF 2-3 YR ITEMS	-6044224.	-6044224.	-6044224.	-6802992.	-7558883.	-8314772.	-9826545.	-10584399.	-10584399.	-10584399.
DPEM DOLLARS	-15857.	-15894.	-15915.	-17804.	-6570.	-7278.	-4946.	-5342.	-5181.	-5181.

Table 27k: Derivatives for End Item TF039 with Respect to C005 Sortie Length in Hours

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
	FISCAL YEAR									
TOTAL GROSS RQMTS	3623154.	3623154.	3623154.	4076056.	4528951.	4981848.	5887640.	6340539.	6340539.	6340539.
SERVICEABLE ASSETS	93573.	93124.	92937.	104554.	115886.	126505.	149506.	160979.	160979.	160979.
BASE REPAIRS	0.	0.	0.	0.	0.	414.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	119291.	119740.	119927.	133262.	17718.	20045.	18538.	19992.	19594.	19594.
ON ORDER ASSETS	13876.	11965.	11965.	13460.	14956.	16452.	19443.	19854.	19854.	19854.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	152101.	154011.	154011.	173429.	323335.	355669.	425977.	458744.	459143.	459143.
BUY OF 2-3 YR ITEMS	3244324.	3244324.	3244324.	3651357.	4057065.	4462772.	5274185.	5680978.	5680978.	5680978.
DPEM DOLLARS	8765.	8784.	8796.	9849.	3621.	4011.	2720.	2937.	2849.	2849.

Table 27m: Derivatives for End Item TF039 with Respect to C005 Day RRR WRSK Repair Arrives

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 27n: Derivatives for End Item TF039 with Respect to C005 Day WHSL Resupply Arrives

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	1390457.	1390457.	1390457.	1564262.	1738072.	1911875.	2259496.	2433300.	2433300.	2433300.
SERVICEABLE ASSETS	36743.	36572.	36498.	41061.	45511.	49740.	58784.	63296.	63296.	63296.
BASE REPAIRS	0.	0.	0.	0.	0.	100.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	47412.	47583.	47657.	53104.	7005.	7928.	7255.	7822.	7665.	7665.
ON ORDER ASSETS	5201.	4473.	4473.	5032.	5591.	6150.	7268.	7397.	7397.	7397.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	60282.	61010.	61010.	68700.	128445.	141289.	169211.	182227.	182384.	182384.
BUY OF 2-3 YR ITEMS	1240827.	1240827.	1240827.	1396375.	1551528.	1706679.	2016986.	2172569.	2172569.	2172569.
DPEM DOLLARS	3485.	3492.	3497.	3920.	1434.	1589.	1075.	1161.	1126.	1126.

Table 28a: Derivatives for End Item B052 with Respect to B052 Peacetime Target Percentage Availability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	42361.	38322.	38271.	36969.	34310.	33437.	33437.	33437.	33437.	33437.
SERVICEABLE ASSETS	11701.	9284.	5794.	8933.	8144.	7875.	7873.	7870.	7868.	7867.
BASE REPAIRS	3956.	56.	4235.	3982.	3632.	3517.	3517.	20.	19.	13.
VALUE DEPOT REPAIRS	4204.	7671.	7533.	6653.	6294.	6129.	6031.	9524.	9491.	9484.
ON ORDER ASSETS	66.	84.	91.	82.	62.	16.	16.	2.	34.	35.
BUY OF 0-1 YR ITEMS	67.	64.	65.	52.	46.	45.	47.	47.	47.	47.
BUY OF 1-2 YR ITEMS	21529.	20358.	19744.	16623.	15518.	15248.	15347.	15367.	15372.	15383.
BUY OF 2-3 YR ITEMS	839.	805.	811.	644.	616.	607.	607.	607.	607.	607.
DPEM DOLLARS	824.	1682.	1606.	1413.	1334.	1292.	1263.	1462.	1451.	1449.

Table 28b: Derivatives for End Item B052 with Respect to B052 Peacetime Target Percentage Probability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	124604.	112793.	118127.	124296.	118815.	117383.	117383.	117383.	117383.	117383.
SERVICEABLE ASSETS	2670.	2057.	1455.	1633.	1481.	1383.	1369.	1340.	1321.	1318.
BASE REPAIRS	1781.	355.	795.	845.	778.	780.	778.	175.	168.	117.
VALUE DEPOT REPAIRS	20882.	20510.	22686.	24295.	24181.	23803.	23759.	24330.	24042.	23981.
ON ORDER ASSETS	439.	534.	597.	710.	537.	141.	140.	17.	294.	305.
BUY OF 0-1 YR ITEMS	445.	407.	427.	448.	400.	395.	409.	411.	411.	412.
BUY OF 1-2 YR ITEMS	92784.	83844.	86836.	90764.	86072.	85574.	85622.	85804.	85841.	85944.
BUY OF 2-3 YR ITEMS	5609.	5092.	5337.	5606.	5372.	5311.	5311.	5311.	5311.	5311.
DPEM DOLLARS	4580.	4652.	4822.	5111.	5072.	4933.	4927.	4956.	4864.	4850.

Table 28c: Derivatives for End Item B052 with Respect to B052 Deaccumulated OIM Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	1535.	1576.	1555.	1532.	1549.	1554.	1554.	1554.	1554.	1554.
SERVICEABLE ASSETS	25.	22.	16.	13.	12.	11.	11.	11.	10.	10.
BASE REPAIRS	17.	6.	6.	7.	7.	7.	7.	3.	3.	2.
VALUE DEPOT REPAIRS	285.	317.	327.	327.	346.	346.	346.	349.	345.	344.
ON ORDER ASSETS	10.	12.	13.	13.	11.	4.	4.	0.	4.	4.
BUY OF 0-1 YR ITEMS	8.	9.	8.	8.	7.	8.	8.	8.	8.	8.
BUY OF 1-2 YR ITEMS	1133.	1151.	1126.	1107.	1107.	1120.	1120.	1125.	1126.	1127.
BUY OF 2-3 YR ITEMS	57.	59.	58.	57.	58.	58.	58.	58.	58.	58.
DPEM DOLLARS	68.	79.	76.	75.	80.	79.	79.	79.	78.	77.

Table 28d: Derivatives for End Item B052 with Respect to B052 Accumulated OIM Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	17448.	17448.	17448.	17448.	17448.	17448.	17448.	17448.	17448.	17448.
SERVICEABLE ASSETS	94.	81.	60.	30.	29.	27.	26.	24.	23.	23.
BASE REPAIRS	12004.	11989.	12000.	12013.	12014.	12014.	12015.	12014.	12014.	12013.
VALUE DEPOT REPAIRS	5318.	5346.	5354.	5370.	5371.	5371.	5371.	5374.	5374.	5374.
ON ORDER ASSETS	11.	11.	12.	12.	12.	3.	3.	0.	1.	1.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	16.	16.	17.	17.	17.	28.	28.	31.	31.	32.
BUY OF 2-3 YR ITEMS	5.	5.	5.	5.	5.	5.	5.	5.	5.	5.
DPEM DOLLARS	617.	623.	625.	628.	628.	628.	628.	629.	628.	628.

Table 28e: Derivatives for End Item B052 with Respect to B052 Deaccumulated PDM Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	22831.	22831.	22831.	22831.	22831.	22831.	22831.	22831.	22831.	22831.
SERVICEABLE ASSETS	265.	146.	104.	42.	27.	26.	26.	24.	20.	13.
BASE REPAIRS	94.	32.	19.	24.	37.	24.	21.	8.	9.	7.
VALUE DEPOT REPAIRS	18071.	17280.	17185.	17476.	17505.	17468.	17462.	17459.	17437.	17443.
ON ORDER ASSETS	344.	350.	329.	368.	368.	27.	20.	1.	10.	10.
BUY OF 0-1 YR ITEMS	254.	254.	254.	254.	244.	244.	244.	247.	247.	250.
BUY OF 1-2 YR ITEMS	3409.	4374.	4545.	4272.	4248.	4641.	4657.	4691.	4706.	4706.
BUY OF 2-3 YR ITEMS	395.	395.	395.	395.	402.	402.	402.	402.	402.	402.
DPEM DOLLARS	7917.	7959.	7849.	7866.	7872.	7849.	7848.	7845.	7836.	7838.

Table 28f: Derivatives for End Item B052 with Respect to B052 Accumulated PDM Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	640950.	640950.	640950.	640950.	640950.	640950.	640950.	640950.	640950.	640950.
SERVICEABLE ASSETS	6976.	3822.	2721.	1113.	708.	683.	683.	617.	524.	328.
BASE REPAIRS	2574.	987.	488.	616.	979.	626.	563.	230.	244.	197.
VALUE DEPOT REPAIRS	617837.	622147.	623363.	624685.	624695.	624853.	624900.	625279.	625198.	625332.
ON ORDER ASSETS	3884.	3937.	3588.	3749.	3749.	195.	128.	0.	12.	12.
BUY OF 0-1 YR ITEMS	558.	558.	558.	558.	556.	558.	558.	564.	564.	594.
BUY OF 1-2 YR ITEMS	1630.	2008.	2740.	2736.	2735.	6509.	6593.	6734.	6884.	6961.
BUY OF 2-3 YR ITEMS	7494.	7494.	7494.	7494.	7527.	7527.	7527.	7527.	7527.	7527.
DPEM DOLLARS	242618.	243825.	244275.	244474.	244460.	244515.	244545.	244583.	244519.	244570.

Table 28g: Derivatives for End Item B052 with Respect to B052 Deaccumulated EOH Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	31.	31.	31.	31.	31.	31.	31.	31.	31.	31.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	31.	31.	31.	31.	31.	31.	31.	31.	31.	31.
BUY OF 1-2 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 28h: Derivatives for End Item B052 with Respect to B052 Accumulated EOH Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	819.	819.	819.	819.	819.	819.	819.	819.	819.	819.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	819.	819.	819.	819.	819.	819.	819.	819.	819.	819.
BUY OF 1-2 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 28i: Derivatives for End Item B052 with Respect to B052 Wartime Target Percentage Availability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	2211716.	2053730.	1895753.	1790443.	1632468.	1579809.	1579809.	1579809.	1579809.	1579809.
SERVICEABLE ASSETS	76630.	68052.	61590.	23373.	21311.	20624.	20624.	20624.	20624.	19953.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	327201.	311178.	301691.	410291.	514830.	501281.	498017.	498017.	498017.	498688.
ON ORDER ASSETS	4283.	48241.	44530.	42056.	3161.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	39433.	36616.	33800.	31922.	22629.	21899.	25163.	25163.	25163.	25163.
BUY OF 1-2 YR ITEMS	1764186.	1589672.	1454167.	1282813.	1070542.	1036009.	1036009.	1036009.	1036009.	1036009.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OPEM DOLLARS	97121.	93940.	90061.	97502.	117372.	113971.	113137.	113137.	113137.	113257.

Table 28j: Derivatives for End Item B052 with Respect to B052 Wartime Target Percentage Probability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	481442.	447053.	412664.	389739.	355350.	343887.	343887.	343887.	343887.	343887.
SERVICEABLE ASSETS	17852.	16277.	14932.	8832.	8052.	7793.	7793.	7793.	7793.	7748.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	57960.	54704.	52232.	70490.	92933.	90577.	90198.	90198.	90198.	90243.
ON ORDER ASSETS	899.	8604.	7943.	7501.	663.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	5934.	5510.	5086.	4804.	3694.	3574.	3954.	3954.	3954.	3954.
BUY OF 1-2 YR ITEMS	398798.	361959.	332472.	298113.	250008.	241943.	241943.	241943.	241943.	241943.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OPEM DOLLARS	15024.	14435.	13762.	14923.	18813.	18287.	18190.	18190.	18190.	18198.

Table 28k: Derivatives for End Item B052 with Respect to B052 Sorties/Day Per Aircraft

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	198878016.	184672208.	170466672.	160996160.	146790560.	142055216.	142055216.	142055216.	142055216.	142055216.
SERVICEABLE ASSETS	3631068.	3243111.	2829705.	1234526.	1125597.	1080220.	1080220.	1064373.	1049500.	1029372.
BASE REPAIRS	1385120.	599773.	179578.	254142.	202700.	196161.	196161.	197059.	190390.	177186.
VALUE DEPOT REPAIRS	25075584.	24909024.	29790816.	32211728.	34503120.	33651392.	33556864.	33558032.	33571552.	33604880.
ON ORDER ASSETS	2215760.	3411174.	3113680.	2846891.	1519691.	437628.	437628.	0.	0.	0.
BUY OF 0-1 YR ITEMS	2265516.	2103693.	1941870.	1833986.	1444196.	1397608.	1492150.	1492150.	1492150.	1492150.
BUY OF 1-2 YR ITEMS	147656256.	134946000.	118340624.	109137360.	95706912.	93400304.	93400304.	93851696.	93859712.	93859712.
BUY OF 2-3 YR ITEMS	16649765.	15460494.	14271224.	13478379.	12289111.	11892687.	11892687.	11892687.	11892687.	11892687.
OPEM DOLLARS	6003063.	6175267.	6017596.	6118733.	6618326.	6438815.	6414645.	6418567.	6418599.	6426445.

Table 28m: Derivatives for End Item B052 with Respect to B052 Attrition, Percentage Loss/Sortie

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	-38568032.	-35813104.	-33058192.	-31221712.	-28466896.	-27548528.	-27548528.	-27548528.	-27548528.	-27548528.
SERVICEABLE ASSETS	-691588.	-619843.	-537867.	-266351.	-242849.	-233566.	-233566.	-231042.	-228647.	-225405.
BASE REPAIRS	-289214.	-124321.	-39949.	-56573.	-44872.	-43424.	-43424.	-43580.	-41738.	-39606.
VALUE DEPOT REPAIRS	-4950212.	-4896246.	-6426620.	-6868469.	-7214756.	-7024777.	-7007448.	-7007633.	-7010566.	-7015940.
ON ORDER ASSETS	-388707.	-677374.	-619621.	-565367.	-263959.	-69053.	-69053.	0.	0.	0.
BUY OF 0-1 YR ITEMS	-485759.	-451062.	-416365.	-393233.	-319536.	-309228.	-326558.	-326558.	-326558.	-326558.
BUY OF 1-2 YR ITEMS	-28124688.	-25666304.	-21899664.	-20126784.	-17695936.	-17270192.	-17270192.	-17341424.	-17342736.	-17342736.
BUY OF 2-3 YR ITEMS	-3638628.	-3378727.	-3118824.	-2945556.	-2685654.	-2599018.	-2599018.	-2599018.	-2599018.	-2599018.
OPEM DOLLARS	-1125595.	-1148658.	-1132503.	-1146607.	-1237341.	-1202986.	-1198555.	-1199176.	-1199326.	-1200591.

Table 28n: Derivatives for End Item B052 with Respect to B052 Sortie Length in Hours

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	31165216.	28939216.	26713088.	25229072.	23002960.	22260768.	22260768.	22260768.	22260768.	22260768.
SERVICEABLE ASSETS	568118.	507571.	442658.	195383.	178143.	170997.	170997.	168553.	166257.	163150.
BASE REPAIRS	218532.	94562.	28507.	40347.	32162.	31125.	31125.	31264.	30180.	28141.
VALUE DEPOT REPAIRS	3935801.	3908166.	4714866.	5092273.	5444341.	5309095.	5294352.	5294532.	5296672.	5301816.
ON ORDER ASSETS	344302.	535692.	489068.	447080.	235953.	67451.	67451.	0.	0.	0.
BUY OF 0-1 YR ITEMS	358340.	332745.	307149.	290085.	229137.	221745.	236489.	236489.	236489.	236489.
BUY OF 1-2 YR ITEMS	23102320.	21111024.	18470000.	17028608.	14936355.	14576437.	14576437.	14646011.	14647250.	14647250.
BUY OF 2-3 YR ITEMS	2638429.	2449969.	2261510.	2135871.	1947411.	1884591.	1884591.	1884591.	1884591.	1884591.
DPEM DOLLARS	937978.	964226.	940547.	956003.	1033855.	1005756.	1001986.	1002591.	1002606.	1003818.

Table 28o: Derivatives for End Item B052 with Respect to B052 Day RRR WRSK Repair Arrives

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 28p: Derivatives for End Item B052 with Respect to B052 Day WHSL Resupply Arrives

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	4963617.	4609067.	4254521.	4018163.	3663608.	3545421.	3545421.	3545421.	3545421.	3545421.
SERVICEABLE ASSETS	93751.	83582.	73665.	24995.	22789.	21756.	21756.	21234.	20750.	20095.
BASE REPAIRS	29870.	12905.	2961.	4396.	3538.	3424.	3424.	3450.	3420.	2992.
VALUE DEPOT REPAIRS	603836.	604748.	597507.	664756.	744111.	728462.	725910.	725949.	726205.	727289.
ON ORDER ASSETS	64215.	80775.	73416.	67297.	44550.	14588.	14588.	0.	0.	0.
BUY OF 0-1 YR ITEMS	46051.	42762.	39473.	37280.	27134.	26259.	28811.	28811.	28811.	28811.
BUY OF 1-2 YR ITEMS	3807098.	3488275.	3194256.	2961369.	2586198.	2523241.	2523241.	2538286.	2538543.	2538543.
BUY OF 2-3 YR ITEMS	318875.	296099.	273322.	258137.	235360.	227768.	227768.	227768.	227768.	227768.
DPEM DOLLARS	158275.	164975.	157869.	161715.	175602.	171025.	170372.	170502.	170468.	170723.

Table 29a: Derivatives for End Item C005 with Respect to C005 Peacetime Target Percentage Availability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	1313.	1314.	1314.	1394.	1465.	1538.	1674.	1736.	1736.	1736.
SERVICEABLE ASSETS	34.	21.	18.	12.	8.	6.	4.	4.	4.	4.
BASE REPAIRS	11.	18.	10.	13.	16.	12.	12.	11.	9.	9.
VALUE DEPOT REPAIRS	199.	203.	215.	229.	238.	234.	247.	256.	253.	251.
ON ORDER ASSETS	12.	12.	6.	8.	9.	7.	8.	8.	10.	10.
BUY OF 0-1 YR ITEMS	19.	19.	19.	20.	26.	28.	33.	34.	34.	34.
BUY OF 1-2 YR ITEMS	214.	214.	217.	231.	243.	279.	304.	317.	320.	320.
BUY OF 2-3 YR ITEMS	826.	826.	830.	880.	926.	972.	1065.	1105.	1105.	1107.
DPEM DOLLARS	38.	39.	40.	43.	44.	41.	44.	46.	46.	46.

Table 29b: Derivatives for End Item C005 with Respect to C005 Peacetime Target Percentage Probability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	25905.	26149.	27763.	28384.	31539.	33514.	36302.	35638.	35638.	35638.
SERVICEABLE ASSETS	662.	423.	381.	236.	168.	133.	92.	88.	85.	84.
BASE REPAIRS	217.	368.	211.	267.	345.	265.	251.	227.	191.	193.
VALUE DEPOT REPAIRS	3918.	4042.	4534.	4670.	5123.	5101.	5368.	5257.	5201.	5154.
ON ORDER ASSETS	230.	229.	124.	168.	186.	160.	174.	171.	201.	201.
BUY OF 0-1 YR ITEMS	366.	378.	401.	411.	557.	608.	714.	701.	703.	703.
BUY OF 1-2 YR ITEMS	4220.	4260.	4585.	4698.	5233.	6070.	6602.	6514.	6577.	6577.
BUY OF 2-3 YR ITEMS	16293.	16450.	17527.	17934.	19930.	21178.	23103.	22681.	22681.	22728.
DPEM DOLLARS	743.	776.	841.	867.	955.	901.	963.	940.	954.	944.

Table 29c: Derivatives for End Item C005 with Respect to C005 Deaccumulated OIM Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	343.	342.	331.	327.	310.	301.	290.	293.	293.	293.
SERVICEABLE ASSETS	14.	9.	7.	5.	3.	2.	1.	1.	1.	1.
BASE REPAIRS	9.	11.	8.	9.	9.	7.	6.	6.	6.	6.
VALUE DEPOT REPAIRS	62.	64.	65.	65.	59.	54.	49.	49.	49.	48.
ON ORDER ASSETS	5.	5.	3.	3.	3.	3.	2.	2.	3.	3.
BUY OF 0-1 YR ITEMS	8.	9.	8.	8.	9.	9.	9.	9.	10.	10.
BUY OF 1-2 YR ITEMS	77.	76.	75.	74.	70.	74.	71.	73.	73.	73.
BUY OF 2-3 YR ITEMS	169.	168.	165.	163.	156.	152.	150.	151.	151.	152.
DPEM DOLLARS	11.	12.	12.	12.	11.	9.	8.	8.	9.	9.

Table 29d: Derivatives for End Item C005 with Respect to C005 Accumulated OIM Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	3814.	3814.	3814.	3814.	3814.	3814.	3814.	3814.	3814.	3814.
SERVICEABLE ASSETS	49.	27.	14.	9.	6.	5.	3.	3.	3.	2.
BASE REPAIRS	2977.	2995.	3004.	3006.	3008.	3006.	3005.	3005.	3005.	3005.
VALUE DEPOT REPAIRS	762.	766.	770.	772.	773.	776.	777.	778.	778.	777.
ON ORDER ASSETS	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
BUY OF 0-1 YR ITEMS	1.	1.	1.	1.	2.	2.	2.	2.	2.	2.
BUY OF 1-2 YR ITEMS	19.	19.	19.	19.	19.	20.	20.	20.	21.	21.
BUY OF 2-3 YR ITEMS	4.	4.	5.	5.	5.	5.	5.	5.	5.	5.
DPEM DOLLARS	88.	89.	90.	90.	91.	91.	91.	91.	91.	91.

Table 29e: Derivatives for End Item C005 with Respect to C005 Deaccumulated PDM Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	100012.	100012.	100012.	100012.	100012.	100012.	100012.	100012.	100012.	100012.
SERVICEABLE ASSETS	315.	120.	72.	49.	49.	18.	18.	14.	2.	2.
BASE REPAIRS	72.	76.	37.	15.	15.	15.	5.	8.	7.	7.
VALUE DEPOT REPAIRS	26751.	26942.	27030.	27017.	27008.	26794.	26613.	26562.	26554.	26554.
ON ORDER ASSETS	74.	74.	0.	7.	7.	0.	0.	1.	1.	1.
BUY OF 0-1 YR ITEMS	524.	524.	524.	524.	526.	533.	590.	590.	601.	601.
BUY OF 1-2 YR ITEMS	36163.	36163.	36163.	36173.	36179.	36423.	36461.	36511.	36520.	36520.
BUY OF 2-3 YR ITEMS	36116.	36116.	36190.	36231.	36231.	36231.	36329.	36329.	36329.	36329.
DPEM DOLLARS	7000.	7038.	7051.	7055.	7052.	6973.	6953.	6941.	6941.	6941.

Table 29f: Derivatives for End Item C005 with Respect to C005 Accumulated PDM Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	2607569.	2607569.	2607569.	2607569.	2607569.	2607569.	2607569.	2607569.	2607569.	2607569.
SERVICEABLE ASSETS	8269.	3192.	1868.	1265.	1265.	473.	473.	364.	64.	64.
BASE REPAIRS	1888.	1978.	1006.	446.	446.	447.	168.	250.	246.	246.
VALUE DEPOT REPAIRS	2592716.	2597701.	2599995.	2600963.	2600938.	2601711.	2601760.	2601552.	2601823.	2601823.
ON ORDER ASSETS	685.	685.	0.	24.	24.	0.	0.	10.	10.	10.
BUY OF 0-1 YR ITEMS	22.	22.	22.	22.	22.	31.	31.	31.	31.	31.
BUY OF 1-2 YR ITEMS	1697.	1697.	1697.	1727.	1752.	1784.	2012.	2237.	2269.	2269.
BUY OF 2-3 YR ITEMS	2304.	2304.	2988.	3126.	3126.	3126.	3126.	3126.	3126.	3126.
DPEM DOLLARS	308341.	309328.	309672.	309986.	309960.	310121.	310097.	310045.	310096.	310096.

Table 29g: Derivatives for End Item C005 with Respect to C005 Wartime Target Percentage.Availability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	57828.	57828.	57828.	65057.	72285.	79514.	93971.	101200.	101200.	101200.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	427.	427.	427.	481.	534.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	887.	887.	887.	998.	1109.	1808.	2136.	1553.	1553.	1553.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	748.	748.	748.
BUY OF 0-1 YR ITEMS	13630.	13630.	13630.	15333.	17037.	18741.	22148.	23852.	23852.	23852.
BUY OF 1-2 YR ITEMS	35108.	35108.	35108.	39496.	43885.	48273.	57050.	61439.	61439.	61439.
BUY OF 2-3 YR ITEMS	7776.	7776.	7776.	8748.	9720.	10692.	12636.	13608.	13608.	13608.
DPEM DOLLARS	285.	285.	285.	321.	356.	735.	868.	499.	499.	499.

Table 29h: Derivatives for End Item C005 with Respect to C005 Wartime Target Percentage Probability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	15789.	15789.	15789.	17762.	19736.	21709.	25656.	27630.	27630.	27630.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	68.	68.	68.	76.	85.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	164.	164.	164.	185.	205.	319.	377.	287.	287.	287.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	119.	119.	119.
BUY OF 0-1 YR ITEMS	3845.	3845.	3845.	4326.	4807.	5287.	6249.	6729.	6729.	6729.
BUY OF 1-2 YR ITEMS	9649.	9649.	9649.	10856.	12062.	13268.	15680.	16886.	16886.	16886.
BUY OF 2-3 YR ITEMS	2062.	2062.	2062.	2320.	2577.	2835.	3351.	3608.	3608.	3608.
DPEM DOLLARS	53.	53.	53.	59.	66.	127.	150.	92.	92.	92.

Table 29i: Derivatives for End Item C005 with Respect to C005 Sorties/Day Per Aircraft

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	27306288.	27306288.	27306288.	30719392.	34132784.	37546224.	44372768.	47786240.	47786240.	47786240.
SERVICEABLE ASSETS	177720.	85570.	72680.	58829.	63310.	55658.	27614.	28042.	28042.	28042.
BASE REPAIRS	1564231.	1571412.	1540423.	1686999.	1860088.	1837145.	2009922.	2107717.	2068154.	2068154.
VALUE DEPOT REPAIRS	1605358.	1690326.	1734201.	1919489.	2114930.	2208271.	2038102.	2150379.	2145083.	2145083.
ON ORDER ASSETS	111914.	110259.	59025.	128163.	142404.	91380.	107994.	135085.	168925.	168925.
BUY OF 0-1 YR ITEMS	514013.	514013.	514013.	578863.	652687.	758481.	978981.	1054288.	1059584.	1059584.
BUY OF 1-2 YR ITEMS	6058062.	6058062.	6082643.	6881017.	7670324.	8803184.	10491440.	11382703.	11388426.	11388426.
BUY OF 2-3 YR ITEMS	17275616.	17277264.	17303920.	19466832.	21629824.	23792832.	28719568.	30928784.	30928784.	30928784.
DPEM DOLLARS	252531.	299554.	311050.	335791.	370642.	321091.	297949.	295121.	294698.	294698.

Table 29j: Derivatives for End Item C005 with Respect to C005 Attrition, Percentage Loss/Sortie

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	-4923578.	-4923578.	-4923578.	-5539031.	-6154489.	-6769943.	-8000852.	-8616314.	-8616314.	-8616314.
SERVICEABLE ASSETS	-34419.	-13685.	-11612.	-9468.	-10120.	-9034.	-4660.	-4702.	-4702.	-4702.
BASE REPAIRS	-115707.	-116526.	-110187.	-115019.	-125577.	-88483.	-63857.	-55600.	-49362.	-49362.
VALUE DEPOT REPAIRS	-263278.	-283193.	-291605.	-323696.	-355391.	-375596.	-360673.	-382151.	-380892.	-380892.
ON ORDER ASSETS	-22522.	-22246.	-14198.	-25315.	-28128.	-21073.	-24905.	-31105.	-36402.	-36402.
BUY OF 0-1 YR ITEMS	-81484.	-81484.	-81484.	-91765.	-103651.	-122550.	-162127.	-174598.	-175857.	-175857.
BUY OF 1-2 YR ITEMS	-1012995.	-1012995.	-1016727.	-1151273.	-1284399.	-1481255.	-1772086.	-1923866.	-1924807.	-1924807.
BUY OF 2-3 YR ITEMS	-3393229.	-3393504.	-3397821.	-3822551.	-4247276.	-4672008.	-5612602.	-6044342.	-6044342.	-6044342.
DPEM DOLLARS	-43605.	-54533.	-56802.	-61560.	-67866.	-58377.	-53916.	-53068.	-52968.	-52968.

Table 29k: Derivatives for End Item C005 with Respect to C005 Sortie Length in Hours

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	2275525.	2275525.	2275525.	2559969.	2844416.	3128866.	3697748.	3982202.	3982202.	3982202.
SERVICEABLE ASSETS	14810.	7131.	6057.	4902.	5276.	4638.	2301.	2337.	2337.	2337.
BASE REPAIRS	130353.	130951.	128369.	140583.	155007.	153096.	167494.	175643.	172346.	172346.
VALUE DEPOT REPAIRS	133780.	140860.	144517.	159958.	176244.	184023.	169842.	179198.	178757.	178757.
ON ORDER ASSETS	9326.	9188.	4919.	10680.	11867.	7615.	9000.	11257.	14077.	14077.
BUY OF 0-1 YR ITEMS	42834.	42834.	42834.	48239.	54391.	63207.	81582.	87857.	88299.	88299.
BUY OF 1-2 YR ITEMS	504839.	504839.	506888.	573419.	639195.	733599.	874288.	948560.	949037.	949037.
BUY OF 2-3 YR ITEMS	1439629.	1439767.	1441988.	1622238.	1802485.	1982736.	2393300.	2577402.	2577402.	2577402.
DPEM DOLLARS	21044.	24963.	25921.	27983.	30887.	26758.	24829.	24593.	24558.	24558.

Table 29m: Derivatives for End Item C005 with Respect to C005 Day RRR WRSK Repair Arrives

	FISCAL YEAR									
DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 29n: Derivatives for End Item C005 with Respect to C005 Day WHSL Resupply Arrives

	FISCAL YEAR									
DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	615633.	615633.	615633.	692587.	769542.	846497.	1000406.	1077360.	1077360.	1077360.
SERVICEABLE ASSETS	3845.	2622.	2231.	1786.	1942.	1670.	777.	797.	797.	797.
BASE REPAIRS	5602.	5804.	5254.	4932.	5021.	3096.	2290.	1718.	477.	477.
VALUE DEPOT REPAIRS	47418.	48438.	49379.	54462.	60342.	62159.	54070.	56789.	56732.	56732.
ON ORDER ASSETS	2149.	2101.	484.	2581.	2868.	1000.	1182.	1515.	2587.	2587.
BUY OF 0-1 YR ITEMS	14776.	14776.	14776.	16642.	18738.	21299.	26503.	28542.	28599.	28599.
BUY OF 1-2 YR ITEMS	173041.	173041.	173848.	196317.	218556.	248988.	295117.	319804.	319973.	319973.
BUY OF 2-3 YR ITEMS	368805.	368853.	369663.	415871.	462079.	508287.	620470.	668198.	668198.	668198.
DPEM DOLLARS	6850.	7434.	7660.	8238.	9115.	8051.	7520.	7573.	7568.	7568.

Table 30a: Derivatives for End Item C135 with Respect to C135 Peacetime Target Percentage Availability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	9335.	9309.	9352.	9337.	9603.	9636.	9634.	9631.	9647.	9647.
SERVICEABLE ASSETS	1754.	1601.	1576.	1556.	448.	447.	447.	436.	429.	428.
BASE REPAIRS	248.	187.	119.	99.	1200.	1196.	1175.	1185.	1184.	1184.
VALUE DEPOT REPAIRS	1667.	1832.	1914.	1799.	1815.	1827.	1829.	1819.	1808.	1795.
ON ORDER ASSETS	52.	65.	68.	92.	39.	31.	25.	19.	20.	20.
BUY OF 0-1 YR ITEMS	811.	812.	817.	815.	844.	847.	853.	853.	855.	855.
BUY OF 1-2 YR ITEMS	2779.	2786.	2820.	2935.	3128.	3151.	3150.	3165.	3193.	3207.
BUY OF 2-3 YR ITEMS	2025.	2027.	2038.	2041.	2128.	2137.	2155.	2154.	2158.	2158.
DPEM DOLLARS	428.	457.	477.	429.	408.	411.	408.	401.	393.	388.

Table 30b: Derivatives for End Item C135 with Respect to C135 Peacetime Target Percentage Probability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	69114.	69100.	69642.	69466.	72181.	72458.	72440.	72414.	72549.	72549.
SERVICEABLE ASSETS	2390.	1120.	897.	713.	407.	399.	393.	292.	232.	226.
BASE REPAIRS	2252.	1694.	1086.	904.	1157.	1121.	923.	1017.	1006.	1008.
VALUE DEPOT REPAIRS	15106.	16626.	17410.	16356.	16572.	16673.	16691.	16599.	16498.	16381.
ON ORDER ASSETS	474.	592.	615.	836.	357.	279.	232.	178.	178.	178.
BUY OF 0-1 YR ITEMS	7350.	7368.	7430.	7411.	7700.	7730.	7787.	7784.	7799.	7799.
BUY OF 1-2 YR ITEMS	23189.	23304.	23664.	24697.	26564.	26758.	26751.	26888.	27144.	27264.
BUY OF 2-3 YR ITEMS	18355.	18399.	18543.	18552.	19426.	19500.	19665.	19658.	19695.	19695.
DPEM DOLLARS	3883.	4148.	4336.	3903.	3726.	3753.	3719.	3657.	3585.	3543.

Table 30c: Derivatives for End Item C135 with Respect to C135 Deaccumulated OIM Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	416.	416.	415.	415.	411.	410.	410.	410.	410.	410.
SERVICEABLE ASSETS	13.	6.	4.	3.	2.	2.	2.	2.	1.	1.
BASE REPAIRS	18.	12.	8.	7.	7.	7.	6.	6.	6.	6.
VALUE DEPOT REPAIRS	100.	111.	115.	107.	104.	104.	103.	102.	101.	101.
ON ORDER ASSETS	6.	7.	7.	7.	2.	2.	1.	1.	1.	1.
BUY OF 0-1 YR ITEMS	35.	35.	35.	35.	34.	34.	35.	35.	35.	35.
BUY OF 1-2 YR ITEMS	152.	153.	154.	163.	168.	168.	168.	169.	171.	171.
BUY OF 2-3 YR ITEMS	93.	93.	93.	93.	93.	93.	95.	95.	95.	95.
DPEM DOLLARS	30.	32.	33.	29.	27.	27.	27.	26.	26.	25.

Table 30d: Derivatives for End Item C135 with Respect to C135 Accumulated OIM Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	5390.	5390.	5390.	5390.	5390.	5390.	5390.	5390.	5390.	5390.
SERVICEABLE ASSETS	58.	17.	13.	7.	4.	4.	4.	3.	2.	2.
BASE REPAIRS	4145.	4152.	4140.	4140.	4142.	4141.	4139.	4140.	4139.	4140.
VALUE DEPOT REPAIRS	1147.	1181.	1195.	1197.	1197.	1198.	1199.	1199.	1199.	1199.
ON ORDER ASSETS	11.	12.	13.	12.	1.	1.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	1.	1.	1.	1.
BUY OF 1-2 YR ITEMS	15.	15.	16.	20.	31.	31.	31.	32.	32.	32.
BUY OF 2-3 YR ITEMS	13.	14.	14.	14.	14.	14.	16.	16.	16.	16.
DPEM DOLLARS	238.	246.	249.	249.	249.	249.	249.	248.	248.	248.

Table 30e: Derivatives for End Item C135 with Respect to C135 Deaccumulated PDM Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	13502.	13502.	13502.	13502.	13502.	13502.	13502.	13502.	13502.	13502.
SERVICEABLE ASSETS	176.	48.	21.	19.	18.	18.	18.	18.	14.	14.
BASE REPAIRS	62.	22.	20.	7.	6.	5.	5.	5.	7.	7.
VALUE DEPOT REPAIRS	11423.	11521.	11457.	11286.	11273.	11275.	11189.	11173.	11163.	11157.
ON ORDER ASSETS	42.	36.	83.	248.	68.	54.	42.	11.	11.	11.
BUY OF 0-1 YR ITEMS	132.	136.	136.	136.	136.	136.	153.	153.	153.	153.
BUY OF 1-2 YR ITEMS	1377.	1406.	1452.	1471.	1528.	1542.	1542.	1589.	1602.	1608.
BUY OF 2-3 YR ITEMS	291.	334.	334.	336.	473.	473.	553.	553.	553.	553.
DPEM DOLLARS	1466.	1485.	1477.	1460.	1459.	1459.	1432.	1422.	1416.	1414.

Table 30f: Derivatives for End Item C135 with Respect to C135 Accumulated PDM Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	268044.	268044.	268044.	268044.	268044.	268044.	268044.	268044.	268044.	268044.
SERVICEABLE ASSETS	4595.	1243.	548.	488.	481.	481.	481.	481.	372.	372.
BASE REPAIRS	1611.	583.	521.	182.	168.	125.	125.	125.	171.	171.
VALUE DEPOT REPAIRS	259350.	262220.	261266.	260243.	260122.	260164.	259808.	259771.	259751.	259702.
ON ORDER ASSETS	804.	527.	1044.	2125.	806.	447.	140.	21.	21.	21.
BUY OF 0-1 YR ITEMS	52.	102.	117.	117.	117.	117.	209.	209.	209.	209.
BUY OF 1-2 YR ITEMS	1038.	1779.	2957.	3293.	4362.	4720.	4720.	4876.	4959.	5009.
BUY OF 2-3 YR ITEMS	595.	1592.	1592.	1598.	1991.	1991.	2562.	2562.	2562.	2562.
DPEM DOLLARS	50677.	51331.	51219.	50989.	50998.	51009.	50898.	50873.	50846.	50836.

Table 30g: Derivatives for End Item C135 with Respect to C135 Deaccumulated EOH Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	97.	97.	97.	97.	97.	97.	97.	97.	97.	97.
SERVICEABLE ASSETS	97.	40.	40.	40.	37.	37.	37.	37.	37.	37.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	57.	57.	57.	60.	60.	60.	60.	60.	60.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	0.	14.	14.	14.	15.	15.	15.	15.	15.	15.

Table 30h: Derivatives for End Item C135 with Respect to C135 Accumulated EOH Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	2524.	2524.	2524.	2524.	2524.	2524.	2524.	2524.	2524.	2524.
SERVICEABLE ASSETS	2524.	1044.	1044.	1044.	956.	956.	956.	956.	956.	956.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	1480.	1480.	1480.	1569.	1569.	1569.	1569.	1569.	1569.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	0.	371.	371.	371.	401.	401.	401.	401.	401.	401.

Table 30i: Derivatives for End Item C135 with Respect to C135 Wartime Target Percentage Availability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	1871134.	1854863.	1854863.	1854863.	1854863.	1854863.	1854863.	1854863.	1854863.	1854863.
SERVICEABLE ASSETS	62007.	61468.	61468.	9863.	2992.	2992.	2992.	2992.	2992.	2992.
BASE REPAIRS	165498.	13799.	13799.	13799.	20670.	6871.	6871.	6871.	6871.	6871.
VALUE DEPOT REPAIRS	469499.	615676.	615676.	667281.	667281.	681080.	681080.	681080.	681080.	681080.
ON ORDER ASSETS	8826.	8750.	8750.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	254925.	252708.	252708.	252708.	252708.	252708.	252708.	252708.	252708.	252708.
BUY OF 1-2 YR ITEMS	869777.	862214.	862214.	870963.	870963.	870963.	870963.	870963.	870963.	870963.
BUY OF 2-3 YR ITEMS	40603.	40250.	40250.	40250.	40250.	40250.	40250.	40250.	40250.	40250.
OPEM DOLLARS	89128.	107601.	107601.	111036.	111036.	115807.	115807.	115807.	115807.	115807.

Table 30j: Derivatives for End Item C135 with Respect to C135 Wartime Target Percentage Probability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	403363.	399856.	399856.	399856.	399856.	399856.	399856.	399856.	399856.	399856.
SERVICEABLE ASSETS	12642.	12532.	12532.	3387.	980.	980.	980.	980.	980.	980.
BASE REPAIRS	36690.	2264.	2264.	2264.	4671.	2407.	2407.	2407.	2407.	2407.
VALUE DEPOT REPAIRS	104180.	137381.	137381.	146526.	146526.	148790.	148790.	148790.	148790.	148790.
ON ORDER ASSETS	1894.	1877.	1877.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	58541.	58032.	58032.	58032.	58032.	58032.	58032.	58032.	58032.	58032.
BUY OF 1-2 YR ITEMS	183353.	181759.	181759.	183636.	183636.	183636.	183636.	183636.	183636.	183636.
BUY OF 2-3 YR ITEMS	6063.	6011.	6011.	6011.	6011.	6011.	6011.	6011.	6011.	6011.
OPEM DOLLARS	17887.	21842.	21842.	22451.	22451.	23234.	23234.	23234.	23234.	23234.

Table 30k: Deriva•ives for End Item C135 with Respect to C135 Sorties/Day Per Aircraft

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	220785392.	218865584.	218865584.	218865584.	218865584.	218865584.	218865584.	218865584.	218865584.	218865584.
SERVICEABLE ASSETS	4189027.	2108341.	2004122.	620211.	265666.	265666.	265666.	263575.	212911.	207614.
BASE REPAIRS	12772966.	8287913.	5505611.	5163703.	5483690.	5061664.	4460243.	4448485.	4262821.	4268119.
VALUE DEPOT REPAIRS	27532880.	33210352.	35810432.	36785888.	36820432.	37242448.	36158496.	36076656.	35902880.	35434528.
ON ORDER ASSETS	4391550.	4854671.	4794989.	4941543.	755480.	560730.	455088.	455088.	455088.	455088.
BUY OF 0-1 YR ITEMS	27578624.	27338832.	27338832.	27338832.	27338832.	27338832.	27714656.	27714656.	27714656.	27714656.
BUY OF 1-2 YR ITEMS	96289024.	95451824.	95797936.	96401728.	100296864.	100491600.	100491600.	100587280.	100997376.	101465744.
BUY OF 2-3 YR ITEMS	48032336.	47614688.	47614688.	47614688.	47905568.	47905568.	49320752.	49320752.	49320752.	49320752.
OPEM DOLLARS	5799754.	6437521.	6871425.	6916738.	6927976.	7074141.	6583391.	6541999.	6371186.	6029868.

Table 30m: Derivatives for End Item C135 with Respect to C135 Attrition, Percentage Loss/Sortie

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	-39604784.	-39260400.	-39260400.	-39260400.	-39260400.	-39260400.	-39260400.	-39260400.	-39260400.	-39260400.
SERVICEABLE ASSETS	-715731.	-358957.	-337947.	-115037.	-44687.	-44687.	-44687.	-44234.	-36153.	-35030.
BASE REPAIRS	-2694742.	-1787886.	-1252535.	-1180146.	-1242869.	-1159768.	-1042923.	-1040687.	-993678.	-994801.
VALUE DEPOT REPAIRS	-4813789.	-5925624.	-6434977.	-6607161.	-6614788.	-6697887.	-6503276.	-6489328.	-6482663.	-6398585.
ON ORDER ASSETS	-727050.	-800998.	-794550.	-824758.	-121777.	-89429.	-72359.	-72359.	-72359.	-72359.
BUY OF 0-1 YR ITEMS	-5503370.	-5455514.	-5455514.	-5455514.	-5455514.	-5455514.	-5512741.	-5512741.	-5512741.	-5512741.
BUY OF 1-2 YR ITEMS	-17835328.	-17680240.	-17733696.	-17826592.	-18480928.	-18513264.	-18513264.	-18529904.	-18591664.	-18675728.
BUY OF 2-3 YR ITEMS	-7315646.	-7252033.	-7252033.	-7252033.	-7300681.	-7300681.	-7571988.	-7571988.	-7571988.	-7571988.
OPEM DOLLARS	-993754.	-1121836.	-1208643.	-1217293.	-1219419.	-1248199.	-1156745.	-1149637.	-1127047.	-1065773.

Table 30n: Derivatives for End Item C135 with Respect to C135 Sortie Length in Hours

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	31540304.	31266032.	31266032.	31266032.	31266032:	31266032.	31266032.	31266032.	31266032.	31266032.
SERVICEABLE ASSETS	598433.	301190.	286302.	88601.	37952.	37952.	37952.	37654.	30416.	29659.
BASE REPAIRS	1824701.	1183982.	786514.	737670.	783383.	723094.	637176.	635496.	608973.	609730.
VALUE DEPOT REPAIRS	3933263.	4744324.	5115760.	5255111.	5260047.	5320336.	5165492.	5153801.	5128978.	5062069.
ON ORDER ASSETS	627364.	693525.	684999.	705935.	107926.	80104.	65013.	65013.	65013.	65013.
BUY OF 0-1 YR ITEMS	3939802.	3905543.	3905543.	3905543.	3905543.	3905543.	3959233.	3959233.	3959233.	3959233.
BUY OF 1-2 YR ITEMS	13755607.	13635985.	13685431.	13771686.	14328141.	14355962.	14355962.	14369631.	14428215.	14495123.
BUY OF 2-3 YR ITEMS	6861767.	6802099.	6802099.	6802099.	6843653.	6843653.	7045823.	7045823.	7045823.	7045823.
DPEM DOLLARS	828536.	919646.	981633.	988106.	989712.	1010592.	940484.	934571.	910169.	861409.

Table 30o: Derivatives for End Item C135 with Respect to C135 Day RRR WRSK Repair Arrives

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 30p: Derivatives for End Item C135 with Respect to C135 Day WHSL Resupply Arrives

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	5459791.	5412316.	5412316.	5412316.	5412316.	5412316.	5412316.	5412316.	5412316.	5412316.
SERVICEABLE ASSETS	115019.	57240.	55288.	14497.	7461.	7461.	7461.	7426.	5861.	5772.
BASE REPAIRS	217903.	137004.	73554.	67629.	74163.	65530.	52059.	51784.	50508.	50597.
VALUE DEPOT REPAIRS	667097.	781745.	838675.	863423.	863925.	872558.	847603.	845359.	834595.	822670.
ON ORDER ASSETS	127357.	141584.	138911.	141648.	22262.	16607.	13412.	13412.	13412.	13412.
BUY OF 0-1 YR ITEMS	571765.	566793.	566793.	566793.	566793.	566793.	579084.	579084.	579084.	579084.
BUY OF 1-2 YR ITEMS	2222521.	2203194.	2214337.	2233568.	2344709.	2350365.	2350365.	2352920.	2366524.	2378449.
BUY OF 2-3 YR ITEMS	1538199.	1524824.	1524824.	1524824.	1533066.	1533066.	1562396.	1562396.	1562396.	1562396.
DPEM DOLLARS	150726.	162914.	171952.	172908.	173166.	176157.	165301.	164177.	157709.	149019.

Table 31a: Derivatives for End Item C141 with Respect to C141 Peacetime Target Percentage Availability

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	4714.	4781.	5167.	5228.	5290.	5308.	5308.	5308.	5308.	5308.
SERVICEABLE ASSETS	173.	142.	1393.	1392.	1392.	1391.	125.	125.	125.	125.
BASE REPAIRS	514.	83.	28.	19.	20.	19.	13.	13.	13.	12.
VALUE DEPOT REPAIRS	900.	1375.	1181.	1202.	1214.	1217.	2488.	2484.	2484.	2484.
ON ORDER ASSETS	120.	125.	99.	93.	34.	34.	34.	34.	34.	33.
BUY OF 0-1 YR ITEMS	40.	40.	34.	35.	35.	38.	38.	38.	38.	38.
BUY OF 1-2 YR ITEMS	1497.	1524.	1232.	1261.	1286.	1294.	1294.	1295.	1296.	1297.
BUY OF 2-3 YR ITEMS	1470.	1493.	1200.	1226.	1309.	1315.	1316.	1319.	1319.	1319.
DPEM DOLLARS	243.	252.	223.	226.	227.	226.	614.	612.	612.	612.

Table 31b: Derivatives for End Item C141 with Respect to C141 Peacetime Target Percentage Probability

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	48582.	48715.	49756.	49936.	50111.	50162.	50162.	50162.	50162.	50162.
SERVICEABLE ASSETS	588.	244.	288.	273.	269.	251.	68.	66.	66.	61.
BASE REPAIRS	5677.	903.	390.	263.	265.	256.	174.	169.	169.	163.
VALUE DEPOT REPAIRS	7808.	12892.	13658.	13757.	13743.	13722.	13980.	13926.	13925.	13931.
ON ORDER ASSETS	1328.	1359.	1361.	1269.	456.	457.	453.	453.	453.	442.
BUY OF 0-1 YR ITEMS	437.	438.	470.	472.	474.	505.	505.	505.	505.	506.
BUY OF 1-2 YR ITEMS	16520.	16610.	17017.	17189.	17297.	17345.	17346.	17362.	17363.	17379.
BUY OF 2-3 YR ITEMS	16227.	16272.	16576.	16715.	17610.	17629.	17639.	17684.	17684.	17684.
DPEM DOLLARS	1707.	1792.	1867.	1877.	1869.	1853.	1917.	1902.	1901.	1900.

Table 31c: Derivatives for End Item C141 with Respect to C141 Deaccumulated OIM Program

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	172.	172.	170.	170.	170.	170.	170.	170.	170.	170.
SERVICEABLE ASSETS	3.	1.	1.	1.	1.	1.	0.	0.	0.	0.
BASE REPAIRS	22.	5.	2.	2.	2.	2.	1.	1.	1.	1.
VALUE DEPOT REPAIRS	38.	57.	59.	60.	59.	59.	60.	59.	59.	59.
ON ORDER ASSETS	6.	6.	6.	6.	3.	3.	3.	3.	3.	2.
BUY OF 0-1 YR ITEMS	3.	3.	3.	3.	3.	3.	3.	3.	3.	3.
BUY OF 1-2 YR ITEMS	69.	69.	69.	69.	70.	70.	70.	70.	70.	70.
BUY OF 2-3 YR ITEMS	30.	30.	30.	30.	33.	33.	34.	34.	34.	34.
DPEM DOLLARS	8.	8.	9.	9.	8.	8.	9.	8.	8.	8.

Table 31d: Derivatives for End Item C141 with Respect to C141 Accumulated OIM Program

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	1849.	1849.	1849.	1849.	1849.	1849.	1849.	1849.	1849.	1849.
SERVICEABLE ASSETS	35.	9.	2.	1.	1.	1.	0.	0.	0.	0.
BASE REPAIRS	1326.	1271.	1269.	1268.	1268.	1268.	1267.	1267.	1267.	1267.
VALUE DEPOT REPAIRS	478.	558.	567.	569.	569.	569.	570.	570.	570.	570.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
BUY OF 1-2 YR ITEMS	6.	6.	6.	6.	6.	6.	6.	6.	6.	6.
BUY OF 2-3 YR ITEMS	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
DPEM DOLLARS	80.	82.	83.	83.	83.	83.	83.	83.	83.	83.

Table 31e: Derivatives for End Item C141 with Respect to C141 Deaccumulated PDM Program

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	13500.	13500.	13500.	13500.	13500.	13500.	13500.	13500.	13500.	13500.
SERVICEABLE ASSETS	261.	131.	41.	31.	21.	15.	5.	4.	4.	3.
BASE REPAIRS	1058.	236.	12.	7.	7.	11.	7.	3.	3.	2.
VALUE DEPOT REPAIRS	8678.	9539.	9771.	9756.	9710.	9693.	9696.	9487.	9486.	9485.
ON ORDER ASSETS	878.	458.	327.	286.	227.	171.	162.	162.	162.	143.
BUY OF 0-1 YR ITEMS	11.	11.	37.	37.	37.	41.	41.	41.	41.	42.
BUY OF 1-2 YR ITEMS	1971.	1975.	2029.	2068.	2119.	2122.	2124.	2146.	2147.	2167.
BUY OF 2-3 YR ITEMS	642.	1149.	1282.	1316.	1380.	1446.	1465.	1657.	1657.	1657.
DPEM DOLLARS	1697.	1727.	1755.	1753.	1741.	1728.	1729.	1686.	1684.	1683.

Table 31f: Derivatives for End Item C141 with Respect to C141 Accumulated PDM Program

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	352183.	352183.	352183.	352183.	352183.	352183.	352183.	352183.	352183.	352183.
SERVICEABLE ASSETS	6804.	3413.	1081.	797.	539.	390.	127.	98.	98.	86.
BASE REPAIRS	27591.	6155.	305.	193.	176.	284.	171.	76.	76.	63.
VALUE DEPOT REPAIRS	283100.	306270.	312526.	312841.	312696.	312624.	312732.	312699.	312687.	312679.
ON ORDER ASSETS	18606.	6980.	4162.	3421.	1777.	327.	95.	95.	95.	40.
BUY OF 0-1 YR ITEMS	5.	5.	86.	86.	86.	97.	97.	97.	97.	118.
BUY OF 1-2 YR ITEMS	3718.	3742.	4937.	5028.	5415.	5417.	5422.	5479.	5491.	5558.
BUY OF 2-3 YR ITEMS	12361.	25619.	29089.	29819.	31496.	33046.	33541.	33641.	33641.	33641.
DPEM DOLLARS	55146.	56141.	56932.	57003.	57071.	56974.	57007.	57067.	57053.	57046.

Table 31g: Derivatives for End Item C141 with Respect to C141 Deaccumulated EOH Program

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	47.	47.	47.	47.	47.	47.	47.	47.	47.	47.
SERVICEABLE ASSETS	2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	44.	44.	44.	44.	44.	44.	44.	44.	44.	44.
BUY OF 1-2 YR ITEMS	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 31h: Derivatives for End Item C141 with Respect to C141 Accumulated EOH Program

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	3328.	3328.	3328.	3328.	3328.	3328.	3328.	3328.	3328.	3328.
SERVICEABLE ASSETS	57.	57.	57.	57.	57.	57.	57.	57.	57.	57.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	3182.	3182.	3182.	3182.	3182.	3182.	3182.	3182.	3182.	3182.
BUY OF 1-2 YR ITEMS	89.	89.	89.	89.	89.	89.	89.	89.	89.	89.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 31i: Derivatives for End Item C141 with Respect to C141 Wartime Target Percentage Availability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	1054817.	1054817.	1054817.	1054817.	1054817.	1054817.	1054817.	1054817.	1054817.	1054817.
SERVICEABLE ASSETS	34476.	20921.	4684.	225.	225.	225.	225.	225.	225.	225.
BASE REPAIRS	93975.	89908.	18663.	22168.	22168.	22168.	22168.	22168.	22168.	22168.
VALUE DEPOT REPAIRS	346357.	357613.	445095.	446049.	444477.	444477.	444477.	444477.	444477.	444477.
ON ORDER ASSETS	4977.	4977.	4977.	4977.	6549.	6549.	6549.	6549.	6549.	6549.
BUY OF 0-1 YR ITEMS	28371.	28371.	28371.	28371.	28371.	28371.	28371.	28371.	28371.	28371.
BUY OF 1-2 YR ITEMS	461363.	467729.	467729.	467729.	467729.	467729.	467729.	467729.	467729.	467729.
BUY OF 2-3 YR ITEMS	85300.	85300.	85300.	85300.	85300.	85300.	85300.	85300.	85300.	85300.
DPEM DOLLARS	39744.	39348.	48637.	49317.	48961.	48961.	48961.	48961.	48961.	48961.

Table 31j: Derivatives for End Item C141 with Respect to C141 Wartime Target Percentage Probability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	271926.	271926.	271926.	271926.	271926.	271926.	271926.	271926.	271926.	271926.
SERVICEABLE ASSETS	5955.	3620.	699.	59.	59.	59.	59.	59.	59.	59.
BASE REPAIRS	25765.	25024.	3195.	3701.	3701.	3701.	3701.	3701.	3701.	3701.
VALUE DEPOT REPAIRS	97772.	100011.	124762.	124896.	124440.	124440.	124440.	124440.	124440.	124440.
ON ORDER ASSETS	871.	871.	871.	871.	1327.	1327.	1327.	1327.	1327.	1327.
BUY OF 0-1 YR ITEMS	7382.	7382.	7382.	7382.	7382.	7382.	7382.	7382.	7382.	7382.
BUY OF 1-2 YR ITEMS	111769.	112604.	112604.	112604.	112604.	112604.	112604.	112604.	112604.	112604.
BUY OF 2-3 YR ITEMS	22413.	22413.	22413.	22413.	22413.	22413.	22413.	22413.	22413.	22413.
DPEM DOLLARS	9681.	9715.	12128.	12224.	12120.	12120.	12120.	12120.	12120.	12120.

Table 31k: Derivatives for End Item C141 with Respect to C141 Sorties/Day Per Aircraft

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	73715408.	73715408.	73715408.	73715408.	73715408.	73715408.	73715408.	73715408.	73715408.	73715408.
SERVICEABLE ASSETS	1317946.	580930.	144907.	35780.	35084.	25062.	25062.	24421.	24421.	22910.
BASE REPAIRS	14932820.	3908690.	930657.	1008237.	1007364.	1001534.	781263.	779504.	779504.	770010.
VALUE DEPOT REPAIRS	19351424.	30855616.	34138368.	34169920.	33908624.	33810352.	34030624.	33966256.	33966256.	33977264.
ON ORDER ASSETS	2118845.	2171103.	2137311.	1994794.	1053090.	1053090.	1050424.	1050424.	1050424.	1038706.
BUY OF 0-1 YR ITEMS	1502842.	1502842.	1536634.	1536634.	1536634.	1596358.	1596358.	1596358.	1596358.	1596358.
BUY OF 1-2 YR ITEMS	29743584.	29948192.	30079504.	30120032.	30198016.	30252416.	30252416.	30277856.	30277856.	30289568.
BUY OF 2-3 YR ITEMS	4749024.	4749024.	4749024.	4851001.	5977567.	5977567.	5980233.	6021552.	6021552.	6021552.
DPEM DOLLARS	2697523.	2894239.	3195796.	3217785.	3158287.	3121303.	3147446.	3123594.	3123594.	3125794.

Table 31m: Derivatives for End Item C141 with Respect to C141 Attrition, Percentage Loss/Sortie

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	-13101342.	-13101342.	-13101342.	-13101342.	-13101342.	-13101342.	-13101342.	-13101342.	-13101342.	-13101342.
SERVICEABLE ASSETS	-254936.	-121637.	-26856.	-5838.	-5691.	-4095.	-4095.	-3999.	-3999.	-3717.
BASE REPAIRS	-3079728.	-820225.	-210637.	-226690.	-226543.	-225237.	-172784.	-172436.	-172436.	-170544.
VALUE DEPOT REPAIRS	-3470596.	-5820687.	-6505241.	-6510205.	-6468660.	-6451581.	-6504034.	-6493971.	-6493971.	-6496145.
ON ORDER ASSETS	-386481.	-394815.	-388957.	-366992.	-162175.	-162175.	-161718.	-161718.	-161718.	-159746.
BUY OF 0-1 YR ITEMS	-246313.	-246313.	-252171.	-252171.	-252171.	-263867.	-263867.	-263867.	-263867.	-263867.
BUY OF 1-2 YR ITEMS	-4906543.	-4940919.	-4960731.	-4967092.	-4980658.	-4988942.	-4988942.	-4993157.	-4993157.	-4995128.
BUY OF 2-3 YR ITEMS	-756819.	-756819.	-756819.	-772422.	-1005511.	-1005511.	-1005969.	-1012259.	-1012259.	-1012259.
DPEM DOLLARS	-474410.	-512710.	-577589.	-581025.	-571388.	-564449.	-570669.	-566872.	-566872.	-567307.

Table 31n: Derivatives for End Item C141 with Respect to C141 Sortie Length in Hours

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	6142968.	6142968.	6142968.	6142968.	6142968.	6142968.	6142968.	6142968.	6142968.	6142968.
SERVICEABLE ASSETS	109829.	48411.	12076.	2982.	2924.	2089.	2089.	2035.	2035.	1909.
BASE REPAIRS	1244399.	325724.	77555.	84020.	83947.	83461.	65105.	64959.	64959.	64168.
VALUE DEPOT REPAIRS	1612617.	2571304.	2844865.	2847495.	2825721.	2817531.	2835887.	2830523.	2830523.	2831440.
ON ORDER ASSETS	176570.	180925.	178109.	166233.	87757.	87757.	87535.	87535.	87535.	86559.
BUY OF 0-1 YR ITEMS	125237.	125237.	128053.	128053.	128053.	133030.	133030.	133030.	133030.	133030.
BUY OF 1-2 YR ITEMS	2478631.	2495680.	2506622.	2510000.	2516499.	2521032.	2521032.	2523152.	2523152.	2524128.
BUY OF 2-3 YR ITEMS	395752.	395752.	395752.	404250.	498131.	498131.	498353.	501796.	501796.	501796.
DPEM DOLLARS	224794.	241187.	266317.	268149.	263191.	260109.	262288.	260300.	260300.	260483.

Table 31o: Derivatives for End Item C141 with Respect to C141 Day RRR WRSK Repair Arrives

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SERVICEABLE ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Table 31p: Derivatives for End Item C141 with Respect to C141 Day WHSL Resupply Arrives

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	1922612.	1922612.	1922612.	1922612.	1922612.	1922612.	1922612.	1922612.	1922612.	1922612.
SERVICEABLE ASSETS	29174.	10518.	3531.	1052.	1039.	730.	730.	708.	708.	673.
BASE REPAIRS	288573.	71008.	12929.	14418.	14392.	14313.	11764.	11728.	11728.	11636.
VALUE DEPOT REPAIRS	499096.	727837.	788555.	789545.	781424.	778771.	781320.	779288.	779288.	779414.
ON ORDER ASSETS	51479.	53087.	52180.	47583.	33857.	33857.	33784.	33784.	33784.	33455.
BUY OF 0-1 YR ITEMS	44656.	44656.	45563.	45563.	45563.	46820.	46820.	46820.	46820.	46820.
BUY OF 1-2 YR ITEMS	867775.	873646.	877994.	879273.	881412.	88[illegible]196.	883196.	883938.	883938.	884267.
BUY OF 2-3 YR ITEMS	141881.	141881.	141881.	145199.	164945.	164945.	165018.	166366.	166366.	166366.
DPEM DOLLARS	71761.	76091.	81155.	81852.	80047.	79185.	79488.	78753.	78753.	78778.

Table 32a: Derivatives for End Item F004 with Respect to F004 Peacetime Target Percentage Availability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	307916.	350267.	376012.	395409.	372377.	347843.	295682.	267352.	235469.	235469.
SERVICEABLE ASSETS	19139.	11123.	10783.	7441.	3504.	3472.	3262.	3189.	3091.	3069.
BASE REPAIRS	44181.	33433.	32986	33980.	37830.	37408.	6651.	6534.	6364.	6383.
VALUE DEPOT REPAIRS	34815.	59797.	56290.	119505.	56300.	56530.	113954.	108790.	103498.	103495.
ON ORDER ASSETS	2883.	3711.	8097.	7131.	7783.	3928.	2940.	2424.	1909.	1877.
BUY OF 0-1 YR ITEMS	914.	1150.	1143.	914.	1139.	1158.	909.	763.	623.	625.
BUY OF 1-2 YR ITEMS	160494.	183696.	210073.	181838.	208188.	186687.	122125.	107255.	88515.	88520.
BUY OF 2-3 YR ITEMS	45494.	57361.	56644.	44603.	57637.	58663.	45844.	38399.	31470.	31503.
DPEM DOLLARS	5565.	10418.	9398.	11950.	9374.	9346.	12868.	12226.	11552.	11551.

Table 32b: Derivatives for End Item F004 with Respect to F004 Peacetime Target Percentage Probability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	229508.	238632.	244254.	248694.	240804.	233458.	220764.	212434.	201584.	201584.
SERVICEABLE ASSETS	4479.	2541.	2348.	1722.	894.	855.	747.	717.	674.	638.
BASE REPAIRS	5310.	4184.	4152.	4365.	4527.	4284.	1292.	1238.	1161.	1193.
VALUE DEPOT REPAIRS	33988.	38574.	38845.	44917.	38759.	37647.	44897.	43228.	41630.	41624.
ON ORDER ASSETS	3613.	3852.	4212.	4130.	3961.	3933.	3568.	3379.	3091.	3039.
BUY OF 0-1 YR ITEMS	1146.	1194.	1222.	1233.	1188.	1160.	1104.	1063.	1009.	1011.
BUY OF 1-2 YR ITEMS	123966.	128737.	132917.	132111.	131371.	126851.	113530.	109276.	103074.	103082.
BUY OF 2-3 YR ITEMS	57008.	59553.	60560.	60217.	60107.	58732.	55631.	53535.	50948.	51000.
DPEM DOLLARS	4583.	5202.	5194.	5481.	5236.	5045.	5487.	5283.	5043.	5042.

Table 32c: Derivatives for End Item F004 with Respect to F004 Deaccumulated OIM Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	1386.	1381.	1378.	1376.	1383.	1390.	1400.	1407.	1420.	1420.
SERVICEABLE ASSETS	20.	9.	7.	6.	4.	4.	4.	4.	4.	3.
BASE REPAIRS	12.	11.	10.	10.	10.	9.	4.	4.	4.	4.
VALUE DEPOT REPAIRS	145.	157.	153.	158.	156.	157.	174.	176.	181.	181.
ON ORDER ASSETS	17.	17.	19.	19.	19.	18.	17.	17.	17.	16.
BUY OF 0-1 YR ITEMS	8.	8.	8.	8.	8.	8.	8.	8.	8.	8.
BUY OF 1-2 YR ITEMS	853.	849.	850.	847.	854.	859.	857.	861.	865.	865.
BUY OF 2-3 YR ITEMS	331.	331.	330.	329.	332.	334.	336.	338.	341.	341.
DPEM DOLLARS	19.	21.	20.	20.	21.	21.	23.	23.	23.	23.

Table 32d: Derivatives for End Item F004 with Respect to F004 Accumulated OIM Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	12035.	12035.	12035.	12035.	12035.	12035.	12035.	12035.	12035.	12035.
SERVICEABLE ASSETS	97.	58.	52.	47.	43.	43.	43.	43.	43.	28.
BASE REPAIRS	8012.	8032.	8031.	8033.	8034.	8032.	8027.	8027.	8027.	8042.
VALUE DEPOT REPAIRS	3855.	3875.	3876.	3877.	3880.	3882.	3886.	3886.	3886.	3886.
ON ORDER ASSETS	2.	2.	7.	6.	6.	2.	1.	1.	1.	1.
BUY OF 0-1 YR ITEMS	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
BUY OF 1-2 YR ITEMS	58.	58.	60.	62.	62.	66.	67.	67.	67.	67.
BUY OF 2-3 YR ITEMS	9.	9.	9.	10.	10.	10.	10.	10.	10.	10.
DPEM DOLLARS	594.	598.	598.	598.	598.	599.	599.	599.	599.	599.

Table 32e: Derivatives for End Item F004 with Respect to F004 Deaccumulated PDM Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	12372.	12372.	12372.	12372.	12372.	12372.	12372.	12372.	12372.	12372.
SERVICEABLE ASSETS	626.	83.	73.	73.	73.	73.	72.	72.	71.	71.
BASE REPAIRS	5.	17.	11.	4.	3.	3.	3.	0.	0.	0.
VALUE DEPOT REPAIRS	9846.	10117.	9852.	9776.	9756.	9728.	9720.	9710.	9701.	9697.
ON ORDER ASSETS	319.	556.	508.	344.	270.	282.	254.	236.	133.	129.
BUY OF 0-1 YR ITEMS	81.	81.	87.	95.	77.	77.	82.	82.	82.	85.
BUY OF 1-2 YR ITEMS	1215.	1140.	1457.	1665.	1730.	1746.	1764.	1792.	1814.	1816.
BUY OF 2-3 YR ITEMS	280.	376.	383.	416.	463.	463.	478.	479.	570.	574.
DPEM DOLLARS	1077.	1088.	1065.	1055.	1053.	1048.	1046.	1044.	1043.	1042.

Table 32f: Derivatives for End Item F004 with Respect to F004 Accumulated PDM Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	323996.	323996.	323996.	323996.	323996.	323996.	323996.	323996.	323996.	323996.
SERVICEABLE ASSETS	16333.	2178.	1914.	1906.	1893.	1893.	1873.	1869.	1857.	1857.
BASE REPAIRS	177.	452.	298.	105.	90.	77.	77.	4.	4.	0.
VALUE DEPOT REPAIRS	303566.	310071.	306342.	306028.	305956.	305898.	305885.	305906.	305906.	305899.
ON ORDER ASSETS	667.	7572.	4488.	869.	512.	423.	310.	260.	162.	142.
BUY OF 0-1 YR ITEMS	30.	30.	59.	123.	123.	123.	141.	147.	147.	156.
BUY OF 1-2 YR ITEMS	2764.	3056.	10222.	14106.	14368.	14528.	14595.	14685.	14748.	14749.
BUY OF 2-3 YR ITEMS	461.	638.	673.	860.	1055.	1055.	1115.	1126.	1173.	1193.
DPEM DOLLARS	34229.	34711.	34576.	34564.	34554.	34546.	34540.	34546.	34547.	34555.

Table 32g: Derivatives for End Item F004 with Respect to F004 Deaccumulated EOH Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	4407.	4407.	4407.	4407.	4407.	4407.	4407.	4407.	4407.	4407.
SERVICEABLE ASSETS	1437.	1355.	1267.	1061.	1061.	1030.	1019.	1019.	1019.	1019.
BASE REPAIRS	0.	77.	0.	43.	0.	0.	2.	2.	2.	2.
VALUE DEPOT REPAIRS	559.	563.	728.	891.	934.	964.	974.	974.	974.	974.
ON ORDER ASSETS	2399.	2399.	2399.	2399.	2399.	2399.	2399.	2399.	2399.	2399.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	13.	13.	13.	13.	13.	13.	13.	13.	13.	13.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	43.	44.	71.	104.	112.	118.	120.	120.	120.	120.

Table 32h: Derivatives for End Item F004 with Respect to F004 Accumulated EOH Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	227749.	227749.	227749.	227749.	227749.	227749.	227749.	227749.	227749.	227749.
SERVICEABLE ASSETS	39902.	37770.	35484.	30116.	30116.	29308.	29014.	29014.	29014.	29014.
BASE REPAIRS	0.	2016.	0.	1127.	0.	13.	52.	52.	52.	52.
VALUE DEPOT REPAIRS	183882.	183998.	188300.	192541.	193668.	194463.	194717.	194717.	194717.	194717.
ON ORDER ASSETS	3045.	3045.	3045.	3045.	3045.	3045.	3045.	3045.	3045.	3045.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	921.	921.	921.	921.	921.	921.	921.	921.	921.	921.
BUY OF 2-3 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DPEM DOLLARS	24695.	24725.	25419.	26284.	26494.	26636.	26687.	26687.	26687.	26687.

Table 32i: Derivatives for End Item F004 with Respect to F004 Wartime Target Percentage Availability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	32227072.	30962384.	30657504.	30025248.	29392768.	29087888.	29392768.	29697696.	29697696.	29697696.
SERVICEABLE ASSETS	422440.	180551.	142047.	135725.	127667.	127165.	127667.	128169.	128169.	69176.
BASE REPAIRS	153056.	179176.	154161.	107051.	100352.	53259.	9412.	9516.	9516.	68509.
VALUE DEPOT REPAIRS	1754038.	2010577.	2036529.	1961277.	1930649.	1946048.	2011396.	2032791.	2032791.	2032791.
ON ORDER ASSETS	379047.	344803.	346100.	359250.	383508.	375263.	343246.	312096.	312096.	312096.
BUY OF 0-1 YR ITEMS	314905.	302557.	299458.	293284.	270019.	267105.	270019.	272932.	272932.	272932.
BUY OF 1-2 YR ITEMS	20660976.	19737632.	19550272.	19207408.	18787264.	18603920.	18801920.	19034432.	19034432.	19034432.
BUY OF 2-3 YR ITEMS	8543392.	8207912.	8129726.	7961986.	7794244.	7716058.	7830030.	7908607.	7908607.	7908607.
DPEM DOLLARS	261797.	269597.	267702.	265844.	265755.	264833.	271597.	274420.	274420.	274420.

Table 32j: Derivatives for End Item F004 with Respect to F004 Wartime Target Percentage Probability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	4122850.	3960900.	3923882.	3842902.	3761921.	3724900.	3761921.	3798942.	3798942.	3798942.
SERVICEABLE ASSETS	33887.	20560.	19175.	16796.	13330.	13272.	13330.	13388.	13388.	10267.
BASE REPAIRS	21305.	21934.	19494.	18984.	21426.	17399.	5069.	5116.	5116.	8237.
VALUE DEPOT REPAIRS	157146.	172980.	173652.	168167.	166023.	167763.	181866.	183593.	183593.	183593.
ON ORDER ASSETS	35495.	31524.	32126.	32505.	33237.	32151.	30427.	29140.	29140.	29140.
BUY OF 0-1 YR ITEMS	19416.	18654.	18472.	18091.	16748.	16576.	16748.	16920.	16920.	16920.
BUY OF 1-2 YR ITEMS	2617230.	2505516.	2482445.	2434164.	2381281.	2359079.	2382608.	2407682.	2407682.	2407682.
BUY OF 2-3 YR ITEMS	1238398.	1189759.	1178545.	1154225.	1129906.	1118692.	1131900.	1143131.	1143131.	1143131.
DPEM DOLLARS	19322.	20257.	19956.	19705.	19905.	20068.	21267.	21472.	21472.	21472.

Table 32k: Derivatives for End Item F004 with Respect to F004 Sorties/Day Per Aircraft

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	404465664.	388555264.	385217536.	377263104.	369308672.	365973504.	369308672.	372642560.	372642560.	372642560.
SERVICEABLE ASSETS	4354068.	2669066.	2462498.	2222649.	1850511.	1838937.	1847075.	1855213.	1855213.	1316278.
BASE REPAIRS	2554440.	2615938.	2284500.	2123002.	2353600.	1817336.	530833.	519968.	519968.	1058904.
VALUE DEPOT REPAIRS	21303024.	23262112.	23142464.	22485280.	22220720.	22459344.	23959184.	24172464.	24172464.	24172464.
ON ORDER ASSETS	4445196.	3833920.	4160281.	4208618.	4349625.	3983080.	3703297.	3504033.	3493148.	3493148.
BUY OF 0-1 YR ITEMS	2608596.	2506052.	2483551.	2432281.	2242783.	2221741.	2242783.	2263825.	2263825.	2263825.
BUY OF 1-2 YR ITEMS	271524608.	259834256.	257650912.	252678000.	247098160.	245258048.	247523408.	250025888.	250036768.	250036768.
BUY OF 2-3 YR ITEMS	97690928.	93847120.	93048896.	91126976.	89205120.	88406880.	89513920.	90314336.	90314336.	90314336.
DPEM DOLLARS	2565337.	2785920.	2657067.	2620511.	2660993.	2674260.	2803882.	2829080.	2829080.	2829080.

Table 32m: Derivatives for End Item F004 with Respect to F004 Attrition, Percentage Loss/Sortie

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	-327750144.	-314916352.	-311486464.	-305070080.	-298654464.	-295223296.	-298654464.	-302083840.	-302083840.	-302083840.
SERVICEABLE ASSETS	-3446760.	-1888785.	-1689417.	-1522096.	-1336926.	-1332035.	-1333611.	-1335190.	-1335190.	-876825.
BASE REPAIRS	-1659279.	-1766986.	-1636053.	-1449700.	-1540897.	-1169733.	-301323.	-289351.	-289351.	-747719.
VALUE DEPOT REPAIRS	-14973440.	-17003296.	-16717980.	-16210768.	-16051210.	-16137828.	-17211600.	-17418592.	-17418592.	-17418592.
ON ORDER ASSETS	-3546668.	-2998272.	-3291217.	-3348840.	-3497811.	-3141726.	-2857214.	-2683606.	-2673236.	-2673236.
BUY OF 0-1 YR ITEMS	-2295822.	-2205940.	-2181540.	-2136599.	-1957656.	-1934685.	-1957656.	-1980626.	-1980626.	-1980626.
BUY OF 1-2 YR ITEMS	-218198976.	-208692352.	-206543184.	-202608688.	-198109504.	-196281696.	-198508112.	-200955728.	-200966096.	-200966096.
BUY OF 2-3 YR ITEMS	-83637888.	-80367120.	-79432512.	-77797136.	-76161760.	-75227168.	-76486256.	-77423664.	-77423664.	-77423664.
DPEM DOLLAR	-1912500.	-2138212.	-1990046.	-1969184.	-2015355.	-2004811.	-2099278.	-2122635.	-2122635.	-2122635.

Table 32n: Derivatives for End Item F004 with Respect to F004 Sortie Length in Hours

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	579849984.	557058816.	552023808.	540627200.	529231616.	524196096.	529231616.	534267648.	534267648.	534267648.
SERVICEABLE ASSETS	6213544.	3730501.	3423171.	3088782.	2596013.	2580989.	2590901.	2600810.	2600810.	1820607.
BASE REPAIRS	3518353.	3626770.	3199792.	2948846.	3245952.	2499343.	715921.	699236.	699236.	1479439.
VALUE DEPOT REPAIRS	29739120.	32702608.	32465024.	31531792.	31171712.	31476448.	33577072.	33894880.	33894880.	33894880.
ON ORDER ASSETS	6353304.	5458398.	5936244.	6012000.	6226296.	5680143.	5258810.	4968894.	4952746.	4952746.
BUY OF 0-1 YR ITEMS	3803423.	3654038.	3619623.	3544929.	3264380.	3232140.	3264380.	3296617.	3296617.	3296617.
BUY OF 1-2 YR ITEMS	388617728.	371845632.	368584448.	361487360.	353496832.	350741248.	354125568.	357859584.	357875712.	357875712.
BUY OF 2-3 YR ITEMS	141617712.	136052624.	134807568.	132025056.	129242480.	127997408.	129711152.	130959744.	130959744.	130959744.
DPEM DOLLARS	3619516.	3952187.	3752144.	3702798.	3765522.	3777081.	3959213.	3996364.	3996364.	3996364.

Table 32o: Derivatives for End Item F004 with Respect to F004 Day RRR WRSK Repair Arrives

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	27304400.	26212224.	26212224.	25666176.	25120096.	25120096.	25120096.	25120096.	25120096.	25120096.
SERVICEABLE ASSETS	152411.	129441.	128866.	92657.	46071.	46071.	46071.	46071.	46071.	43299.
BASE REPAIRS	497580.	483667.	376841.	388956.	415835.	316008.	77879.	77879.	77879.	80651.
VALUE DEPOT REPAIRS	1854526.	1796136.	1902975.	1873826.	1843704.	1943305.	2181434.	2181434.	2181434.	2181434.
ON ORDER ASSETS	516590.	494824.	495185.	485313.	475800.	475453.	474388.	473500.	473500.	473500.
BUY OF 0-1 YR ITEMS	136892.	131417.	131417.	128679.	125535.	125535.	125535.	125535.	125535.	125535.
BUY OF 1-2 YR ITEMS	16507333.	15843234.	15843434.	15515983.	15185158.	15185729.	15185729.	15186617.	15186617.	15186617.
BUY OF 2-3 YR ITEMS	7639424.	7333848.	7333848.	7181057.	7028270.	7028270.	7029336.	7029336.	7029336.	7029336.
DPEM DOLLARS	153675.	148656.	165157.	162303.	160340.	177560.	196437.	196437.	196437.	196437.

Table 32p: Derivatives for End Item F004 with Respect to F004 Day WHSL Resupply Arrives

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	18458528.	17734544.	17555280.	17193280.	16831280.	16651979.	16831280.	17010560.	17010560.	17010560.
SERVICEABLE ASSETS	241466.	124833.	111138.	106526.	101348.	101057.	101091.	101126.	101126.	64312.
BASE REPAIRS	24925.	33166.	38288.	23772.	25093.	20408.	6304.	5402.	5402.	42216.
VALUE DEPOT REPAIRS	848360.	1019644.	984801.	944849.	938037.	926128.	950534.	960918.	960918.	960918.
ON ORDER ASSETS	143902.	105677.	131593.	138920.	152469.	125690.	107109.	91224.	90404.	90404.
BUY OF 0-1 YR ITEMS	145796.	140078.	138652.	135793.	123330.	122006.	123330.	124655.	124655.	124655.
BUY OF 1-2 YR ITEMS	13088473.	12500819.	12382033.	12152297.	11877524.	11784796.	11909746.	12052402.	12053222.	12053222.
BUY OF 2-3 YR ITEMS	3965716.	3810418.	3768840.	3691186.	3613536.	3571954.	3633221.	3674893.	3674893.	3674893.
DPEM DOLLARS	123107.	142212.	128185.	126391.	130549.	126036.	128616.	129906.	129906.	129906.

Table 33a: Derivatives for End Item F015 with Respect to F015 Peacetime Target Percentage Availability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	77652.	82832.	88749.	94502.	92406.	105726.	115030.	126608.	143798.	133047.
SERVICEABLE ASSETS	470.	456.	488.	322.	710.	619.	615.	669.	692.	632.
BASE REPAIRS	71.	49.	27.	155.	886.	1009.	990.	1091.	1264.	1166.
VALUE DEPOT REPAIRS	55794.	59204.	62714.	67407.	5123.	5911.	6413.	6832.	7260.	2807.
ON ORDER ASSETS	2202.	720.	545.	563.	1208.	1323.	1407.	1254.	397.	3935.
BUY OF 0-1 YR ITEMS	145.	157.	174.	180.	607.	696.	783.	867.	1018.	973.
BUY OF 1-2 YR ITEMS	3895.	5886.	6482.	6805.	18882.	21758.	23899.	26623.	30632.	28788.
BUY OF 2-3 YR ITEMS	15076.	16360.	18319.	19070.	64992.	74412.	80923.	89274.	102536.	94748.
DPEM DOLLARS	1629.	1736.	1828.	1958.	580.	674.	728.	704.	694.	508.

Table 33b: Derivatives for End Item F015 with Respect to F015 Peacetime Target Percentage Probability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	79674.	83337.	87418.	90820.	89939.	97501.	103900.	111106.	122071.	121356.
SERVICEABLE ASSETS	1511.	1405.	1422.	932.	706.	582.	566.	598.	599.	590.
BASE REPAIRS	227.	151.	79.	449.	880.	949.	912.	976.	1095.	1089.
VALUE DEPOT REPAIRS	14182.	15316.	16378.	17475.	5090.	5559.	5908.	6114.	6285.	2620.
ON ORDER ASSETS	2327.	2219.	1588.	1630.	1200.	1244.	1296.	1123.	344.	3673.
BUY OF 0-1 YR ITEMS	465.	484.	506.	522.	603.	654.	722.	776.	881.	908.
BUY OF 1-2 YR ITEMS	12518.	13336.	14098.	14594.	16885.	18533.	19939.	21623.	24103.	24037.
BUY OF 2-3 YR ITEMS	48445.	50426.	53349.	55218.	64576.	69981.	74556.	79897.	88766.	88442.
DPEM DOLLARS	762.	822.	819.	853.	576.	634.	671.	630.	601.	474.

Table 33c: Derivatives for End Item F015 with Respect to F015 Deaccumulated OIM Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	563.	557.	551.	545.	544.	534.	526.	519.	509.	508.
SERVICEABLE ASSETS	14.	12.	11.	7.	4.	3.	3.	3.	2.	2.
BASE REPAIRS	2.	1.	1.	3.	6.	5.	5.	5.	5.	5.
VALUE DEPOT REPAIRS	38.	40.	38.	37.	26.	25.	24.	22.	19.	10.
ON ORDER ASSETS	19.	15.	10.	10.	7.	6.	6.	4.	2.	9.
BUY OF 0-1 YR ITEMS	5.	5.	5.	4.	5.	4.	5.	4.	4.	5.
BUY OF 1-2 YR ITEMS	126.	128.	128.	127.	129.	127.	126.	125.	124.	124.
BUY OF 2-3 YR ITEMS	360.	357.	358.	356.	367.	362.	358.	355.	353.	353.
DPEM DOLLARS	5.	5.	4.	4.	4.	4.	4.	3.	2.	2.

Table 33d: Derivatives for End Item F015 with Respect to F015 Accumulated OIM Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	6416.	6416.	6416.	6416.	6416.	6416.	6416.	6416.	6416.	6416.
SERVICEABLE ASSETS	189.	181.	180.	110.	23.	21.	20.	20.	14.	14.
BASE REPAIRS	4537.	4539.	4538.	4605.	4691.	4691.	4691.	4691.	4697.	4697.
VALUE DEPOT REPAIRS	1655.	1661.	1662.	1666.	1666.	1666.	1667.	1667.	1667.	1667.
ON ORDER ASSETS	14.	7.	1.	1.	1.	1.	1.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	12.	19.	19.	19.	19.	22.	22.	22.	22.	22.
BUY OF 2-3 YR ITEMS	10.	10.	16.	16.	16.	16.	16.	16.	16.	17.
DPEM DOLLARS	132.	133.	133.	134.	134.	134.	134.	134.	134.	134.

Table 33e: Derivatives for End Item F015 with Respect to F015 Deaccumulated PDM Program

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	1535.	1535.	1535.	1535.	1535.	1535.	1535.	1535.	1535.	1535.
SERVICEABLE ASSETS	33.	10.	6.	1.	1.	1.	1.	1.	1.	1.
BASE REPAIRS	8.	22.	6.	2.	2.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	76.	80.	100.	103.	102.	104.	105.	75.	67.	62.
ON ORDER ASSETS	1.	6.	1.	1.	1.	1.	0.	0.	5.	5.
BUY OF 0-1 YR ITEMS	10.	10.	10.	10.	10.	10.	10.	10.	10.	10.
BUY OF 1-2 YR ITEMS	674.	674.	678.	683.	684.	684.	686.	715.	718.	723.
BUY OF 2-3 YR ITEMS	734.	734.	734.	734.	734.	734.	734.	734.	734.	734.
DPEM DOLLARS	19.	18.	19.	19.	19.	19.	19.	13.	12.	10.

Table 33f: Derivatives for End Item F015 with Respect to F015 Accumulated PDM Program

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	40390.	40390.	40390.	40390.	40390.	40390.	40390.	40390.	40390.	40390.
SERVICEABLE ASSETS	901.	254.	144.	31.	31.	26.	26.	26.	22.	22.
BASE REPAIRS	205.	566.	164.	57.	57.	5.	0.	0.	4.	0.
VALUE DEPOT REPAIRS	39209.	39495.	40007.	40223.	40222.	40279.	40285.	40270.	40266.	40266.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	4.	4.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	70.	70.	70.	74.	75.	75.	75.	89.	89.	93.
BUY OF 2-3 YR ITEMS	5.	5.	5.	5.	5.	5.	5.	5.	5.	5.
DPEM DOLLARS	3076.	3131.	3152.	3203.	3203.	3219.	3220.	3217.	3216.	3215.

Table 33g: Derivatives for End Item F015 with Respect to F015 Wartime Target Percentage Availability

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	4826719.	5096216.	5365706.	5782064.	6198416.	6737384.	7399037.	8060680.	9138666.	9947163.
SERVICEABLE ASSETS	93037.	75923.	75645.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	44643.	41954.	7533.	73093.	76345.	77104.	83273.	89441.	101778.	111030.
VALUE DEPOT REPAIRS	179230.	205232.	257308.	238516.	256299.	284465.	273739.	269296.	264974.	50299.
ON ORDER ASSETS	73636.	59638.	50319.	54096.	57873.	62906.	65492.	71443.	0.	193026.
BUY OF 0-1 YR ITEMS	101110.	106728.	112346.	120777.	129208.	140444.	154484.	173201.	196317.	224572.
BUY OF 1-2 YR ITEMS	1887635.	2023032.	2142570.	2323708.	2496467.	2713543.	3020032.	3312193.	3796088.	4166499.
BUY OF 2-3 YR ITEMS	2447443.	2583725.	2720008.	2971891.	3182245.	3458959.	3802043.	4145127.	4779530.	5201751.
DPEM DOLLARS	30690.	30732.	33722.	29861.	32579.	37051.	39211.	24709.	23294.	9639.

Table 33h: Derivatives for End Item F015 with Respect to F015 Wartime Target Percentage Probability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	886721.	936411.	986100.	1064496.	1142889.	1242267.	1362635.	1483007.	1681769.	1830842.
SERVICEABLE ASSETS	6236.	5589.	5739.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	2659.	2302.	271.	5786.	6203.	6532.	7055.	7577.	8622.	9406.
VALUE DEPOT REPAIRS	51724.	55574.	60826.	63087.	67625.	73716.	78694.	84155.	93006.	2231.
ON ORDER ASSETS	16925.	16060.	16324.	17583.	18843.	20482.	22375.	24381.	0.	96933.
BUY OF 0-1 YR ITEMS	9180.	9692.	10205.	10996.	11787.	12812.	14071.	15500.	17573.	19535.
BUY OF 1-2 YR ITEMS	240110.	255998.	270233.	293152.	315553.	342993.	377979.	412199.	470016.	513452.
BUY OF 2-3 YR ITEMS	559889.	591199.	622508.	673895.	722883.	785742.	862473.	939205.	1092562.	1189295.
DPEM DOLLARS	2853.	2942.	3175.	2934.	3166.	3500.	3759.	3051.	3193.	376.

Table 33i: Derivatives for End Item F015 with Respect to F015 Sorties/Day Per Aircraft

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	46739312.	49381984.	52024496.	56402256.	60779888.	66064912.	72257760.	78450480.	89020864.	96948592.
SERVICEABLE ASSETS	1110126.	1079005.	1118943.	554788.	147592.	157103.	161623.	173426.	112954.	123056.
BASE REPAIRS	245521.	170093.	36692.	612819.	1106895.	1182085.	1285970.	1388382.	1657108.	1806158.
VALUE DEPOT REPAIRS	1976769.	2212064.	2429973.	2504001.	2690390.	2948721.	3050775.	3109596.	3249393.	335855.
ON ORDER ASSETS	1144684.	983290.	804477.	870269.	939662.	1017458.	1126902.	1059264.	173728.	3122137.
BUY OF 0-1 YR ITEMS	604923.	638852.	672781.	726573.	780366.	848223.	937533.	1036933.	1182615.	1337329.
BUY OF 1-2 YR ITEMS	15121311.	16263432.	17238848.	18763984.	20245952.	22010352.	24228960.	26515696.	30281856.	33104208.
BUY OF 2-3 YR ITEMS	26536240.	28035472.	29723072.	32370080.	34869296.	37901424.	41466400.	45167632.	52363712.	57120464.
DPEM DOLLARS	217568.	234118.	225857.	220195.	237888.	264994.	281811.	193631.	175770.	68324.

Table 33j: Derivatives for End Item F015 with Respect to F015 Attrition, Percentage Loss/Sortie

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	-77496704.	-81820288.	-86144048.	-92793984.	-99444016.	-108091232.	-118735760.	-129380560.	-146675296.	-159646208.
SERVICEABLE ASSETS	-1101463.	-1001334.	-1024723.	-335911.	-219131.	-232200.	-238504.	-257322.	-140434.	-152685.
BASE REPAIRS	-417341.	-296390.	-62181.	-682969.	-858467.	-899058.	-982462.	-1063349.	-1350516.	-1471325.
VALUE DEPOT REPAIRS	-2805826.	-3185948.	-3526455.	-3557214.	-3782020.	-4150935.	-4268502.	-4322864.	-4398448.	-569828.
ON ORDER ASSETS	-1778297.	-1490731.	-1071858.	-1142098.	-1218648.	-1317759.	-1483225.	-1340381.	-309930.	-4091306.
BUY OF 0-1 YR ITEMS	-1089172.	-1149952.	-1210732.	-1304347.	-1397961.	-1519523.	-1681475.	-1860801.	-2121799.	-2393006.
BUY OF 1-2 YR ITEMS	-27102272.	-29115376.	-30845312.	-33474016.	-36028944.	-39168752.	-43191552.	-47326752.	-54021872.	-59030896.
BUY OF 2-3 YR ITEMS	-43182704.	-45580944.	-48403152.	-52297936.	-55939344.	-60803648.	-66890816.	-73209584.	-84332768.	-91937648.
DPEM DOLLARS	-355451.	-384601.	-369189.	-355930.	-383444.	-427249.	-454525.	-304381.	-266616.	-114752.

Table 33k: Derivatives for End Item F015 with Respect to F015 Sortie Length in Hours

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	97232656.	102709968.	108187040.	117081184.	125975152.	136929440.	149944320.	162959104.	184868048.	201299520.
SERVICEABLE ASSETS	2050692.	1968965.	2037062.	949751.	298085.	316925.	325911.	350202.	218583.	238024.
BASE REPAIRS	521351.	358876.	76801.	1158266.	1960804.	2087799.	2272817.	2454746.	2958342.	3224201.
VALUE DEPOT REPAIRS	3947198.	4433181.	4879224.	5001030.	5359295.	5875915.	6070143.	6177402.	6413550.	703222.
ON ORDER ASSETS	2339428.	1996690.	1581864.	1705135.	1836018.	1987400.	2209479.	2058028.	369068.	6115165.
BUY OF 0-1 YR ITEMS	1288594.	1360760.	1432927.	1546381.	1659834.	1804167.	1994814.	2206677.	2516555.	2843544.
BUY OF 1-2 YR ITEMS	32167696.	34585472.	36654096.	39861824.	42978944.	46724464.	51460320.	56337792.	64330400.	70317104.
BUY OF 2-3 YR ITEMS	54918304.	58006560.	61525728.	66859360.	71882752.	78133440.	85611424.	93374784.	108062032.	117858848.
DPEM DOLLARS	450760.	485786.	468002.	454868.	491038.	547029.	581801.	396981.	356971.	142650.

Table 33m: Derivatives for End Item F015 with Respect to F015 Day RRR WRSK Repair Arrives

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	3022129.	3199900.	3377672.	3733217.	4088762.	4444303.	4799849.	5155395.	5866482.	6399799.
SERVICEABLE ASSETS	206289.	217749.	229740.	123755.	16512.	17948.	19384.	20820.	23691.	25845.
BASE REPAIRS	1608.	1535.	181.	129992.	261312.	283895.	306607.	329318.	374741.	408809.
VALUE DEPOT REPAIRS	256796.	272373.	289051.	318746.	349087.	379582.	406455.	438146.	497284.	1488.
ON ORDER ASSETS	122512.	128660.	135416.	149671.	163925.	178180.	192394.	206645.	0.	540193.
BUY OF 0-1 YR ITEMS	3161.	3347.	3533.	3905.	4276.	4648.	5020.	5505.	6264.	7105.
BUY OF 1-2 YR ITEMS	127540.	136472.	144444.	159885.	175218.	190454.	207224.	223026.	255084.	278813.
BUY OF 2-3 YR ITEMS	2304224.	2439766.	2575310.	2847265.	3118433.	3389601.	3660770.	3931938.	4709421.	5137550.
DPEM DOLLARS	7513.	7882.	8371.	9135.	10015.	10925.	11748.	12267.	13828.	251.

Table 33n: Derivatives for End Item F015 with Respect to F015 Day WHSL Resupply Arrives

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	3083042.	3257532.	3432039.	3722793.	4013553.	4362553.	4769804.	5177060.	5875069.	6398584.
SERVICEABLE ASSETS	37026.	30187.	30103.	6768.	7106.	7416.	7131.	7558.	699.	760.
BASE REPAIRS	22246.	15589.	3404.	20673.	21594.	21533.	23357.	25035.	35961.	39224.
VALUE DEPOT REPAIRS	95103.	111450.	126102.	123581.	131680.	145377.	143800.	136881.	129584.	32289.
ON ORDER ASSETS	65650.	47590.	33580.	35829.	38422.	41389.	46815.	35078.	16197.	100228.
BUY OF 0-1 YR ITEMS	54136.	57189.	60241.	65220.	70199.	76303.	84271.	93170.	106303.	120626.
BUY OF 1-2 YR ITEMS	1285794.	1386683.	1471530.	1608453.	1741177.	1892958.	2079546.	2273644.	2599152.	2843728.
BUY OF 2-3 YR ITEMS	1523100.	1608874.	1707103.	1862296.	2003398.	2177606.	2384921.	2605726.	2987209.	3261756.
DPEM DOLLARS	18499.	19877.	18887.	18143.	19589.	21885.	23196.	14199.	12057.	6646.

Table 34a: Derivatives for End Item F016 with Respect to F016 Peacetime Target Percentage Availability

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	105000.	134252.	154652.	175588.	187369.	196464.	213741.	225504.	245256.	232324.
SERVICEABLE ASSETS	604.	18.	20.	16.	13.	10.	0.	0.	0.	0.
BASE REPAIRS	75.	0.	0.	7.	0.	4.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	66.	984.	1194.	1293.	1322.	1484.	1715.	1918.	2087.	2153.
ON ORDER ASSETS	2031.	1774.	2043.	2121.	2247.	668.	682.	641.	695.	622.
BUY OF 0-1 YR ITEMS	826.	1056.	1216.	1381.	1473.	1555.	1746.	1842.	2004.	1896.
BUY OF 1-2 YR ITEMS	26958.	35206.	40548.	46098.	49311.	53348.	58026.	61231.	66629.	63029.
BUY OF 2-3 YR ITEMS	74444.	95217.	109631.	124672.	133004.	139396.	151573.	159874.	173841.	164626.
DPEM DOLLARS	13.	961.	1176.	1337.	1458.	1640.	1895.	2123.	2312.	2390.

Table 34b: Derivatives for End Item F016 with Respect to F016 Peacetime Target Percentage Probability

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	110325.	136989.	153741.	167832.	177882.	187910.	203092.	215000.	228130.	226053.
SERVICEABLE ASSETS	102.	18.	20.	15.	13.	10.	0.	0.	0.	0.
BASE REPAIRS	79.	0.	0.	7.	0.	3.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	69.	238.	273.	232.	132.	144.	166.	182.	195.	195.
ON ORDER ASSETS	2144.	1820.	2044.	2039.	2147.	643.	653.	616.	652.	611.
BUY OF 0-1 YR ITEMS	872.	1083.	1216.	1328.	1407.	1497.	1671.	1770.	1879.	1860.
BUY OF 1-2 YR ITEMS	28462.	36126.	40551.	44328.	47112.	51375.	55535.	58830.	62455.	61848.
BUY OF 2-3 YR ITEMS	78599.	97705.	109638.	119884.	127073.	134239.	145068.	153604.	162951.	161541.
DPEM DOLLARS	14.	110.	130.	136.	108.	118.	138.	152.	165.	166.

Table 34c: Derivatives for End Item F016 with Respect to F016 Deaccumulated OIM Program

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	1342.	1275.	1244.	1223.	1208.	1195.	1180.	1169.	1159.	1158.
SERVICEABLE ASSETS	2.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	1.	3.	3.	3.	2.	1.	1.	1.	1.	1.
ON ORDER ASSETS	27.	15.	15.	12.	12.	4.	3.	3.	3.	3.
BUY OF 0-1 YR ITEMS	13.	12.	11.	11.	11.	11.	11.	11.	10.	10.
BUY OF 1-2 YR ITEMS	368.	348.	335.	327.	322.	324.	317.	312.	308.	308.
BUY OF 2-3 YR ITEMS	930.	896.	879.	871.	863.	855.	847.	841.	836.	836.
DPEM DOLLARS	0.	2.	2.	2.	1.	1.	1.	1.	1.	1.

Table 34d: Derivatives for End Item F016 with Respect to F016 Accumulated OIM Program

FISCAL YEAR

DEPENDENT VARIABLE	<-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	8187.	8187.	8187.	8187.	8187.	8187.	8187.	8187.	8187.	8187.
SERVICEABLE ASSETS	6.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	2270.	2267.	2267.	2267.	2267.	2267.	2267.	2267.	2267.	2267.
VALUE DEPOT REPAIRS	5850.	5859.	5859.	5859.	5859.	5859.	5859.	5859.	5859.	5859.
ON ORDER ASSETS	1.	1.	1.	1.	1.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	32.	33.	33.	33.	33.	33.	33.	33.	33.	33.
BUY OF 2-3 YR ITEMS	27.	27.	27.	27.	27.	27.	27.	27.	27.	27.
DPEM DOLLARS	1156.	1162.	1162.	1162.	1161.	1161.	1162.	1162.	1162.	1162.

Table 34e: Derivatives for End Item F016 with Respect to F016 Deaccumulated PDM Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	52.	52.	52.	52.	52.	52.	52.	52.	52.	52.
SERVICEABLE ASSETS	2.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BASE REPAIRS	21.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	11.	22.	22.	22.	1.	1.	0.	0.	0.	0.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	1.	1.	1.	1.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	4.	15.	15.	15.	36.	36.	36.	36.	36.	36.
BUY OF 2-3 YR ITEMS	15.	15.	15.	15.	15.	15.	15.	15.	15.	15.
DPEM DOLLARS	2.	8.	8.	8.	1.	1.	0.	0.	0.	0.

Table 34f: Derivatives for End Item F016 with Respect to F016 Accumulated PDM Program

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	1253.	1253.	1253.	1253.	1253.	1253.	1253.	1253.	1253.	1253.
SERVICEABLE ASSETS	40.	10.	10.	10.	10.	10.	0.	0.	0.	0.
BASE REPAIRS	552.	0.	0.	0.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	391.	973.	973.	973.	945.	945.	954.	954.	954.	954.
ON ORDER ASSETS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 0-1 YR ITEMS	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
BUY OF 1-2 YR ITEMS	2.	2.	2.	2.	29.	29.	29.	29.	29.	29.
BUY OF 2-3 YR ITEMS	269.	269.	269.	269.	269.	269.	269.	269.	269.	269.
DPEM DOLLARS	98.	295.	295.	295.	286.	286.	287.	287.	287.	287.

Table 34g: Derivatives for End Item F016 with Respect to F016 Wartime Target Percentage Availability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	2625751.	3889092.	4766714.	5449699.	6129151.	6907679.	7979934.	8953098.	9731611.	10120894.
SERVICEABLE ASSETS	16301.	6044.	7404.	4962.	5582.	6291.	0.	0.	0.	0.
BASE REPAIRS	19911.	0.	0.	3500.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	10114.	48933.	59995.	50025.	13720.	15467.	15259.	17120.	15110.	15714.
ON ORDER ASSETS	24664.	31785.	40014.	32573.	36483.	41137.	44416.	41644.	45265.	47075.
BUY OF 0-1 YR ITEMS	19170.	28400.	34790.	39760.	44730.	50410.	71410.	80118.	87085.	90569.
BUY OF 1-2 YR ITEMS	492428.	747084.	916421.	1048318.	1224955.	1380613.	1595502.	1798263.	1958126.	2036459.
BUY OF 2-3 YR ITEMS	2043185.	3026874.	3708118.	4270586.	4803696.	5413777.	6253362.	7015966.	7626048.	7931093.
DPEM DOLLARS	2292.	14809.	18172.	17930.	5428.	6120.	8237.	9241.	7894.	8210.

Table 34h: Derivatives for End Item F016 with Respect to F016 Wartime Target Percentage Probability

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	1018338.	1508343.	1848599.	2113379.	2376951.	2678864.	3094601.	3471993.	3773906.	3924867.
SERVICEABLE ASSETS	538.	142.	174.	120.	135.	152.	0.	0.	0.	0.
BASE REPAIRS	968.	0.	0.	79.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	366.	2122.	2601.	2197.	300.	338.	364.	408.	356.	370.
ON ORDER ASSETS	1153.	1498.	[illegible]	1231.	1379.	1555.	1576.	1506.	1637.	1702.
BUY OF 0-1 YR ITEMS	1240.	1836.	2253.	2578.	2898.	3266.	4205.	4718.	5128.	5334.
BUY OF 1-2 YR ITEMS	49557.	74048.	90903.	104042.	119172.	134322.	155288.	174488.	189749.	197339.
BUY OF 2-3 YR ITEMS	964532.	1428716.	1750799.	2003148.	2253082.	2539247.	2933182.	3290889.	3577053.	3720136.
DPEM DOLLARS	79.	628.	770.	761.	119.	134.	199.	223.	189.	197.

Table 34i: Derivatives for End Item F016 with Respect to F016 Sorties/Day Per Aircraft

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	66726640.	98788432.	121201072.	138661552.	155866576.	175675504.	203040400.	227801600.	247610336.	257514784.
SERVICEABLE ASSETS	61714.	22218.	27224.	20066.	22116.	24925.	0.	0.	0.	0.
BASE REPAIRS	99849.	6097.	7582.	19808.	9771.	11022.	12820.	14384.	0.	0.
VALUE DEPOT REPAIRS	50076.	216054.	264986.	235481.	44476.	50139.	56509.	63400.	55570.	57792.
ON ORDER ASSETS	259672.	262173.	325837.	193303.	216532.	244147.	268786.	263414.	286319.	297772.
BUY OF 0-1 YR ITEMS	116884.	172983.	212402.	243138.	273186.	307920.	400618.	449474.	504192.	524360.
BUY OF 1-2 YR ITEMS	4747806.	7134985.	8780694.	10097195.	11564536.	13036611.	15088728.	16964448.	18452944.	19191072.
BUY OF 2-3 YR ITEMS	61391264.	90974624.	111583008.	127853152.	143736608.	162001344.	187213536.	210047056.	228311920.	237444400.
DPEM DOLLARS	10919.	66365.	81449.	82790.	17815.	20086.	31383.	35210.	30069.	31272.

Table 34j: Derivatives for End Item F016 with Respect to F016 Attrition, Percentage Loss/Sortie

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	-112322080.	-166439872.	-203787296.	-232819664.	-261992464.	-295251200.	-340907008.	-382480640.	-415740928.	-432369920.
SERVICEABLE ASSETS	-102755.	-37536.	-45988.	-33805.	-37259.	-41991.	0.	0.	0.	0.
BASE REPAIRS	-169137.	-7978.	-10044.	-30450.	-12968.	-14638.	-17122.	-19210.	0.	0.
VALUE DEPOT REPAIRS	-84143.	-365130.	-447747.	-398159.	-74669.	-84178.	-94189.	-105675.	-93861.	-97615.
ON ORDER ASSETS	-442998.	-448334.	-556805.	-317024.	-354937.	-400226.	-440041.	-428045.	-465266.	-483877.
BUY OF 0-1 YR ITEMS	-202287.	-299495.	-367410.	-420314.	-472488.	-532533.	-691402.	-775720.	-864054.	-898616.
BUY OF 1-2 YR ITEMS	-7365701.	-11119974.	-13590970.	-15561406.	-17922624.	-20195792.	-23300256.	-26203024.	-28502480.	-29642672.
BUY OF 2-3 YR ITEMS	-103955792.	-154162128.	-188769008.	-216059184.	-243118128.	-273983488.	-316371200.	-354957056.	-385822976.	-401256448.
DPEM DOLLARS	-18178.	-112043.	-137491.	-139772.	-29693.	-33479.	-52165.	-58527.	-50705.	-52733.

Table 34k: Derivatives for End Item F016 with Respect to F016 Sortie Length in Hours

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	139403312.	206437360.	253127920.	289479680.	325492736.	366842624.	423870976.	475564288.	516918784.	537596160.
SERVICEABLE ASSETS	128536.	46465.	56932.	41931.	46215.	52084.	0.	0.	0.	0.
BASE REPAIRS	208971.	11937.	14889.	40370.	19195.	21656.	25223.	28299.	0.	0.
VALUE DEPOT REPAIRS	104564.	451877.	554190.	492577.	92848.	104671.	117730.	132087.	116206.	120854.
ON ORDER ASSETS	544557.	550177.	683638.	400913.	449026.	506299.	557193.	544936.	592322.	616015.
BUY OF 0-1 YR ITEMS	246126.	364297.	447196.	511816.	575151.	648267.	842917.	945712.	1058707.	1101054.
BUY OF 1-2 YR ITEMS	9699719.	14594490.	17927872.	20592240.	23619680.	26623344.	30788096.	34617696.	37655264.	39161488.
BUY OF 2-3 YR ITEMS	128471584.	190418800.	233443840.	267400656.	300695808.	338894848.	391549440.	439304448.	477504256.	496605184.
DPEM DOLLARS	22741.	138762.	170296.	173105.	37114.	41847.	65332.	73299.	62850.	65364.

Table 34m: Derivatives for End Item F016 with Respect to F016 Day RRR WRSK Repair Arrives

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	1332527.	1947540.	2460051.	2870058.	3177563.	3587574.	4202588.	4715100.	5125107.	5330113.
SERVICEABLE ASSETS	42.	11.	14.	10.	11.	12.	0.	0.	0.	0.
BASE REPAIRS	76.	0.	0.	6.	0.	0.	0.	0.	0.	0.
VALUE DEPOT REPAIRS	59.	167.	211.	183.	28.	32.	35.	39.	29.	30.
ON ORDER ASSETS	169.	231.	292.	123.	136.	154.	128.	121.	132.	137.
BUY OF 0-1 YR ITEMS	102.	150.	189.	221.	244.	276.	392.	440.	478.	497.
BUY OF 1-2 YR ITEMS	326419.	477171.	602741.	703199.	778722.	879203.	1029924.	1155546.	1256041.	1306283.
BUY OF 2-3 YR ITEMS	1005661.	1469812.	1856605.	2166318.	2398423.	2707899.	3172111.	3558954.	3868428.	4023166.
DPEM DOLLARS	13.	50.	64.	65.	12.	14.	20.	22.	15.	16.

Table 34n: Derivatives for End Item F016 with Respect to F016 Day WHSL Resupply Arrives

DEPENDENT VARIABLE	FISCAL YEAR <-- 1 -->	<-- 2 -->	<-- 3 -->	<-- 4 -->	<-- 5 -->	<-- 6 -->	<-- 7 -->	<-- 8 -->	<-- 9 -->	<--10 -->
TOTAL GROSS RQMTS	5886216.	8718835.	10684807.	12214537.	13738459.	15483391.	17885584.	20066576.	21811152.	22683600.
SERVICEABLE ASSETS	6015.	2208.	2706.	2001.	2205.	2485.	0.	0.	0.	0.
BASE REPAIRS	9885.	446.	564.	1750.	728.	822.	963.	1081.	0.	0.
VALUE DEPOT REPAIRS	4933.	21350.	26189.	23236.	4310.	4859.	5525.	6199.	5524.	5745.
ON ORDER ASSETS	24608.	24296.	30290.	17976.	20107.	22675.	24927.	24252.	26361.	27415.
BUY OF 0-1 YR ITEMS	11288.	16700.	20524.	23508.	26400.	29759.	38790.	43521.	48480.	50419.
BUY OF 1-2 YR ITEMS	341609.	517352.	634097.	727843.	841657.	948567.	1095826.	1232937.	1341363.	1395017.
BUY OF 2-3 YR ITEMS	5487919.	8136526.	9970481.	11418266.	12843089.	14474264.	16719608.	18758800.	20389984.	21205536.
DPEM DOLLARS	1064.	6539.	8027.	8152.	1711.	1930.	3068.	3442.	2994.	3114.

For wartime, the independent variables are:

- Target percentage of aircraft to be available (TFMCS(k) in Sec. 4.6).
- Percentage probability with which target availability is to be achieved (TPROB(k) in Sec. 4.6).
- Sorties per day per possessed aircraft (S(k) in Sec. 4.6).
- Percentage attrition losses per sortie (a(k) in Sec. 4.6).
- Sortie length (L(k) in Sec. 4.6).
- Day that repair is first available for RRR items in the WRSK (R(i) in Sec. 4.6).
- Day that resupply from wholesale is first available (TSUP(k) in Sec. 4.6).

Engines do not have their own wartime scenarios, but there are nevertheless war reserve requirements for engine components. These requirements are driven by the scenarios for the aircraft in which an engine is installed (see Table 4). For each engine, there is a set of wartime derivative tables for each aircraft that uses that engine. For example, the F100 engine is used in both the F-15 and F-16 aircraft, so it has tables of derivatives with respect to both F-15 wartime scenario parameters (Tables 23g-23n) and F-16 wartime scenario parameters (Tables 23o-23u).

Unfortunately, not all of the peacetime program quantities are mutually independent. As explained in Sec. 5.2.2, the peacetime OIM programs for engines are inherited from the OIM programs of the aircraft. Thus, to estimate the effect of increasing F-15 flying hours, one must not only use the F-15 derivative tables for the OIM program (Tables 33c-33d), but one must also compute the effect of changing the F-15 the flying program on the F100 engine program (two engines per aircraft implies two engine flying hours per aircraft flying hour), and then use the F100 derivative tables for the OIM program (Tables 23c-23d). Conversely, it makes no sense to change F100 engine flying hours without making a corresponding change in either the F-15 or F-16 flying program.

Moreover, the accumulated and deaccumulated forms of a program are closely related, whether it be the OIM, PDM, or EOH program for any end item. For example, Table 23c gives derivatives with respect to the deaccumulated OIM program for the F100 engine, and Table 23d gives derivatives with respect to the accumulated version of the same program. To determine the effects of a change in the OIM program, for example, we would first specify, year by year, what the change in hours flown per year will be. For example, we might increase the flying in year 1 by 1000 hours and make no other change. Next, we calculate how this change affects the accumulated flying program. In our example, the cumulated flying hours will increase by 1000 in year 1, but also in year 2, year 3, and every year thereafter.

Finally, we apply the changes in the accumulated and deaccumulated programs to the derivatives. To estimate the effect on the total gross requirement, for example, we carry out a two-step calculation. First we multiply the derivative in each year with respect to the deaccumulated program by the change in that year in the deaccumulated program. In our example, the deaccumulated program changes only in year 1, and then by 1000 hours, so the result is an increase of $148,000 in year 1 and no change in any other year. In the second step of the calculation, we add to this result the analogous result obtained for the accumulated program. In our example, the accumulated program increased in every year by 1000 hours, so we take the derivatives in each year, multiplied by those changes, and add them to the previous result. The final change in total gross requirements resulting from an increase of 1000 F100 flying hours in year 1 is $727,000 in year 1 and $579,000 in every year thereafter.

It may seem strange that an increase in year 1 flying hours affects total gross requirements in later years. But this is just another manifestation of the cumulative nature of the D041 computation. The gross requirements in year 5, for example, did not all originate in year 5; they also include requirements that may have originated at any time before year 5, and which persist. In our example, the $148,000 increase resulting from a change in the deaccumulated program represents additional pipeline and safety stock needed because the flying rate

increased. As soon as the flying rate decreases again, this stock leaves the pipeline and ceases to generate a requirement. The other $579,000 increase in year 1 represents the additional failures of F100 components. Once these have failed, reducing the flying rate will not restore them. This part of the incremental requirement, therefore, persists throughout all the remaining years.

One way of thinking about these tables is the following. Any increase in a program will generate an increment in the total gross requirement, and this requirement must be satisfied by assets of some kind. Therefore, the sum of all the entries below the gross requirements line, leaving out only the DPEM (depot purchased equipment maintenance) line (which is the cost of depot repairs), must equal the entry in the total gross requirements line.

Now we consider how the derivatives change over time. There are two reasons why the derivatives might change. First, the nominal programmed activities and capabilities change, so the mix of items needed may be different from year to year. Second, the assets on hand or on order as of asset cutoff, including components in backlog at the depot, are not a perfect match for the requirements. Some items will be in surplus for the first few years, and when these stocks are finally exhausted and it becomes necessary to repair or buy the item, the derivatives will change.

The second reason explains an initial transient in the system as modeled by D041. Once enough time has passed, assuming that the programmed quantities remain constant or nearly so, the system will achieve a "hand-to-mouth" status, in which items are repaired and bought at the same rates as they fail or are condemned. Once the system reaches this state, it should have no uncommitted serviceable on hand or due in assets and no depot backlog of items with any requirement. Thus, the derivatives of applied serviceable and due in assets should become zero, and the derivatives of actual depot repairs should approach the potential depot repair factors from Tables 22. And as these derivatives tend towards zero, other derivatives must increase, since sources are always identified to fully satisfy the increase in total gross requirements.

The first reason explains continuing fluctuations in the derivatives. But because programs do not tend to fluctuate but instead show long-term trends (e.g., the B-52 program steadily declines, the F-16 rises), one should not see rapid changes over time in the derivatives.

If we look at some actual examples from Tables 23-34, we see that, indeed, the derivatives of applied serviceable and due in assets do decline, although they do not actually reach zero. And the derivatives of depot repairs and base repairs approach the factors from Tables 22.

We think the derivatives in these tables can take the place of, and improve upon, the average cost per flying hour factors that D041 now provides to the programmer in the PPB process, along with the CSIS. It will be interesting, therefore, to try to compare the two approaches. We do not have actual average costs per flying hour, so we will compute them from the net buy and repair costs in Tables 10-21 and from the program information in Tables 7 and 8. We compute the average cost per flying hour in a particular year by differencing requirements in successive years and dividing by single-year *flying* hours. We compare these average costs to the change in buy and repair requirements in a particular year resulting from a change in the OIM program in the same year, as estimated using the derivatives. Thus, the derivatives we use in the comparison are the sums of derivatives with respect to both the deaccumulated and accumulated OIM programs. We also note that for both the average cost method and the method of derivatives, the year in which a buy requirement is incurred is not the year in which the money is obligated. This occurs a procurement lead time earlier, but because it occurs earlier regardless of the method used to estimate the requirement, we will not adjust for lead times in this comparison.

Figures 6 and 7 compare the results for the F100 engine and the F-4 aircraft. For the repair cost the two methods compare quite well, but for the buy cost, the average cost method grossly understates the marginal cost of additional flying hours, as estimated using the derivatives. The reason that the repair factors agree is that components do fail in proportion to flying hours (or at least the D041, the model that underlies both factors, assumes this), so both the

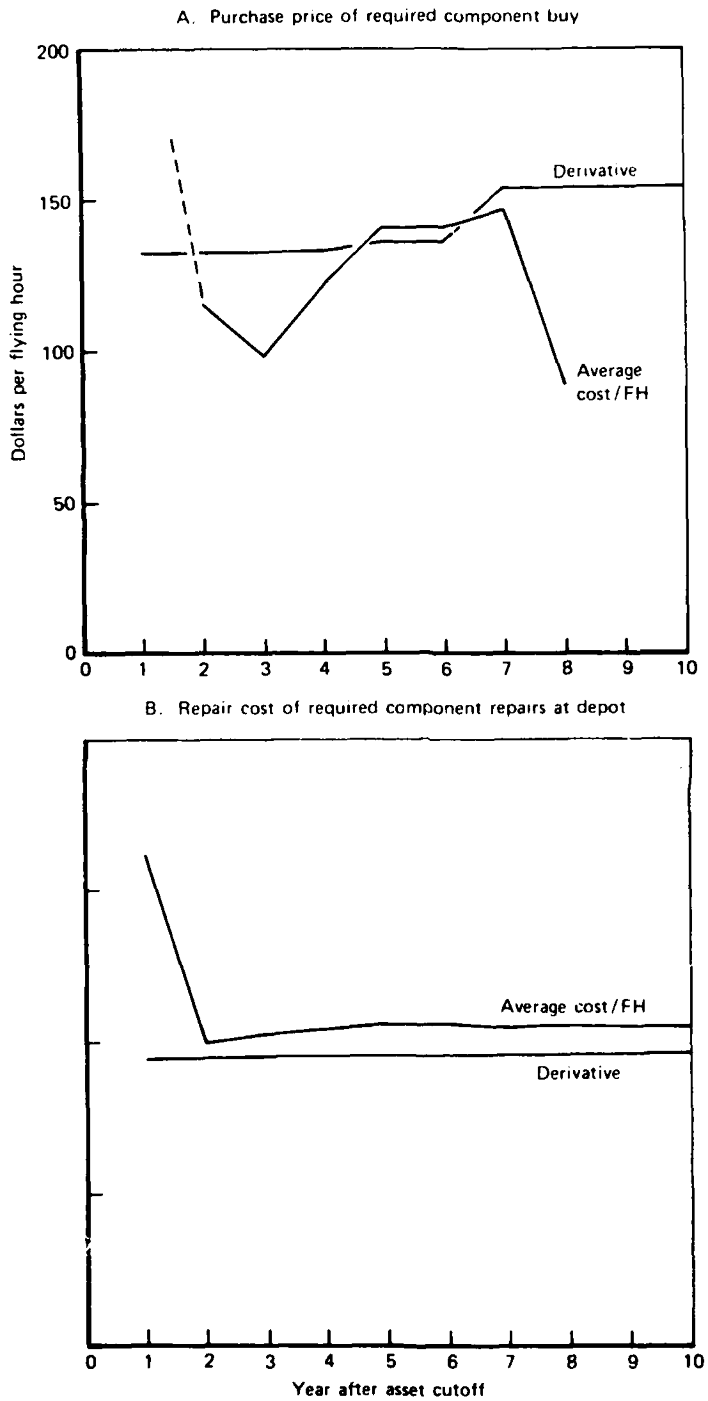


Fig. 6 -- Comparison of derivatives with average costs per flying hour for the F100 engine

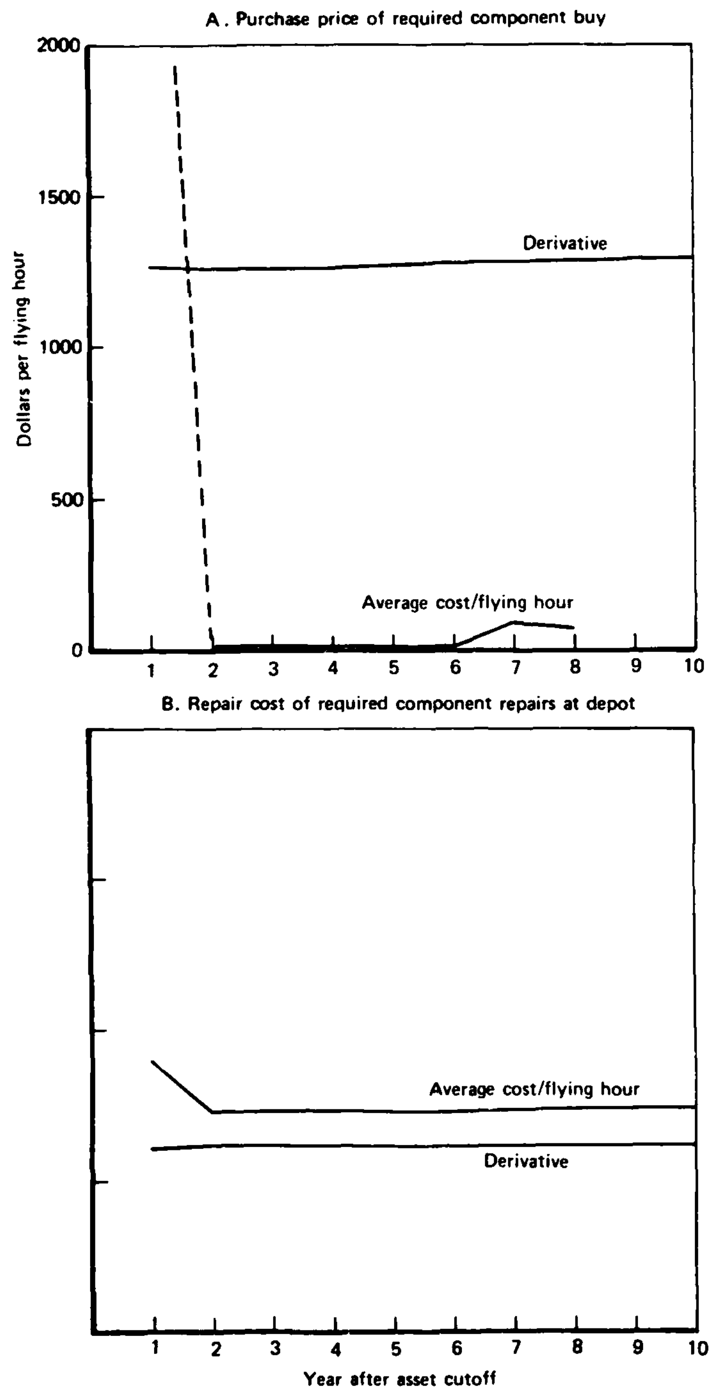


Fig. 7 -- Comparison of derivatives with average costs per flying hour for the F-4 aircraft

requirement and the opportunities for repair grow in proportion to flying hours. Only if a large backlog were repaired in year 1 to satisfy level requirements would the average cost method disagree substantially with the derivative method.

The striking disagreement between the average cost factors and the derivatives for the buy requirement can be explained as follows. The component buy requirement in any year but year 1 serves the purpose of replacing the condemnations of items repaired at either base or depot. But condemnations are generally small, as we pointed out earlier. If we now increase the flying program, we will certainly have to replace more condemnations, but we will in addition have to provide more components to occupy the base and depot pipelines, because the rate of flying has increased. This additional pipeline requirement is not considered in the calculation of the average cost factors and it is much larger than condemnations (see Tables 22).

5.4. VALIDATION

The ORACLE database is intended to provide a way to estimate D041's projections of future requirements for a variety of different programs, without requiring that D041 be exercised for those programs. We can therefore validate our methodology by comparing its estimates of D041's projections with the projections themselves. If we have calculated the derivatives correctly, we are assured that for small changes in the programmed quantities the projections will be nearly the same for both methods. It is only large program changes that may yield poor results. But we have no way of knowing by how much the program can change before the ORACLE database ceases to adequately approximate the item-by-item results. The validation exercise reported here is thus an attempt to discover the range of validity of the ORACLE database. We have carried out this exercise for all 12 end items and obtained similar results for each one. For illustration, we will show the results only for the F100 engine and the F-4 aircraft.

For each of our 12 end items, we have considered 45 different ten-year peacetime programs, computing requirements both by using the derivative Tables 23-34 and by aggregating the item-by-item projections

made by our test version of D041 that generated Tables 10-21. The 45 different programs consisted of all possible combinations of three different OIM programs, three different depot-level maintenance programs (either PDM or EOH, as appropriate for the end item), and five combinations of the target availability and the probability of achieving it. The three OIM programs were the nominal program, a program in which each year's flying was half of the nominal, and a program in which each year's flying was 50 percent larger than nominal. For the PDM and EOH programs we likewise considered the nominal, 0.5 nominal, and 1.5 nominal programs. The five combinations of availability and probability include the nominal, two cases in which only the probability is varied from the nominal (down to 33 percent and up to 67 percent, respectively), and two cases in which only the availability is varied from the nominal. We will present results only for the F100 engine and the F-4 aircraft; for these end items the target availability was lowered to 75 percent in one case, and raised to 92 percent in the others (nominal target availability is 83 percent for both end items).

We have also considered 27 different wartime scenarios for each aircraft. For an individual squadron of aircraft, the scenario is the same in each year of the ten-year program, but because the number of squadrons of each aircraft type may change over time, the scenario for the entire inventory will change over time. The 27 scenarios consist of all combinations of three probabilities of meeting the target availability (33 percent, 50 percent, and 67 percent), combined with nine different sets of choices for the other wartime scenario parameters. Since we show validation results only for the F100 engine and the F-4 aircraft, we need include only the scenario parameters for the aircraft that use the F100 (the F-15 and F-16), and the F-4. These appear in Table 35.

Figures 8 compare the requirements projections made in he two different ways for the F100 engine, and Figs. 9 do the same ior the F-4 aircraft. The ORACLE database can project nine different quantities for each end item (the rows in Tables 23-34), and for each quantity we include two figures. The first figure shows the value estimated using the programmer's database (vertical axis) compared to the value from the

Table 35a: Wartime Scenario Parameters Used for Validation Cases: F-4 Aircraft

SCENARIO PARAMETER	Case 1	Case 2	Case 3	Case 4	Case 5	case 6	Case 7	Case 8	Case 9
ACFT/DEPLOYED SQDN	24	24	24	24	24	24	24	24	24
TARGET AVAIL (%)	83	83	75	83	92	83	75	83	92
TARGET PROB (%)	50	50	50	50	50	50	50	50	50
SORTIES/DAY PER ACFT	2.3	2.3	2.3	2.3	2.3	1.2	1.2	3.4	3.4
ATTRITION, PCT LOSS/SORTIE	0.7	0.7	0.7	0.7	0.7	0.7	0.7	1.2	1.2
SORTIE LENGTH (HRS)	2	2	2	2	2	1	1	3	3
ARRIVAL DAY RRR REPAIR	5	3	3	7	7	5	5	5	5
ARRIVAL DAY WHSL SUPPLY	30	20	20	40	40	30	30	30	30

Table 35b: Wartime Scenario Parameters Used for Validation Cases: F-15 Aircraft

SCENARIO PARAMETER	Case 1	Case 2	Case 3	Case 4	Case 5	case 6	Case 7	Case 8	Case 9
ACFT/DEPLOYED SQDN	24	24	24	24	24	24	24	24	24
TARGET AVAIL (%)	83	83	75	83	92	83	75	83	92
TARGET PROB (%)	50	50	50	50	50	50	50	50	50
SORTIES/DAY PER ACFT	3.0	3.0	3.0	3.0	3.0	1.5	1.5	4.5	4.5
ATTRITION, PCT LOSS/SORTIE	0.7	0.7	0.7	0.7	0.7	0.7	0.7	1.2	1.2
SORTIE LENGTH (HRS)	2	2	2	2	2	1	1	3	3
ARRIVAL DAY RRR REPAIR	5	3	3	7	7	5	5	5	5
ARRIVAL DAY WHSL SUPPLY	30	20	20	40	40	30	30	30	30

Table 35c: Wartime Scenario Parameters Used for Validation Cases: F-16 Aircraft

SCENARIO PARAMETER	Case 1	Case 2	Case 3	Case 4	Case 5	case 6	Case 7	Case 8	Case 9
ACFT/DEPLOYED SQDN	24	24	24	24	24	24	24	24	24
TARGET AVAIL (%)	83	83	75	83	92	83	75	83	92
TARGET PROB (%)	50	50	50	50	50	50	50	50	50
SORTIES/DAY PER ACFT	3.0	3.0	3.0	3.0	3.0	1.5	1.5	4.5	4.5
ATTRITION, PCT LOSS/SORTIE	0.7	0.7	0.7	0.7	0.7	0.7	0.7	1.2	1.2
SORTIE LENGTH (HRS)	2	2	2	2	2	1	1	3	3
ARRIVAL DAY RRR REPAIR	5	3	3	7	7	5	5	5	5
ARRIVAL DAY WHSL SUPPLY	30	20	20	40	40	30	30	30	30

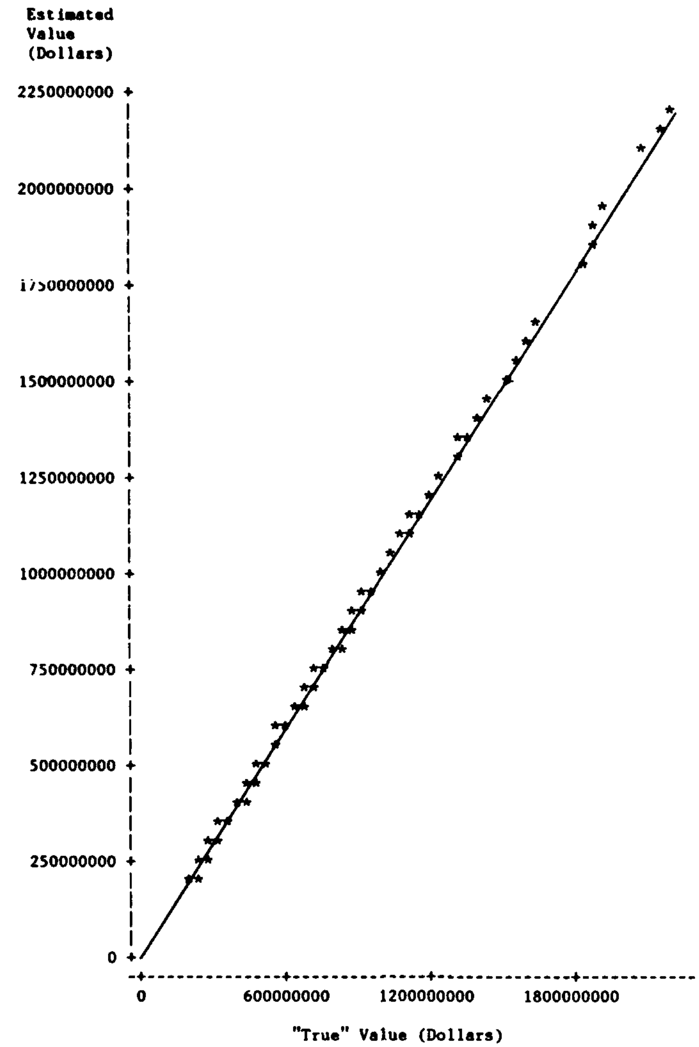


Fig. 8a -- Estimated vs "true" total gross requirements for the F100 engine alternative peacetime programs

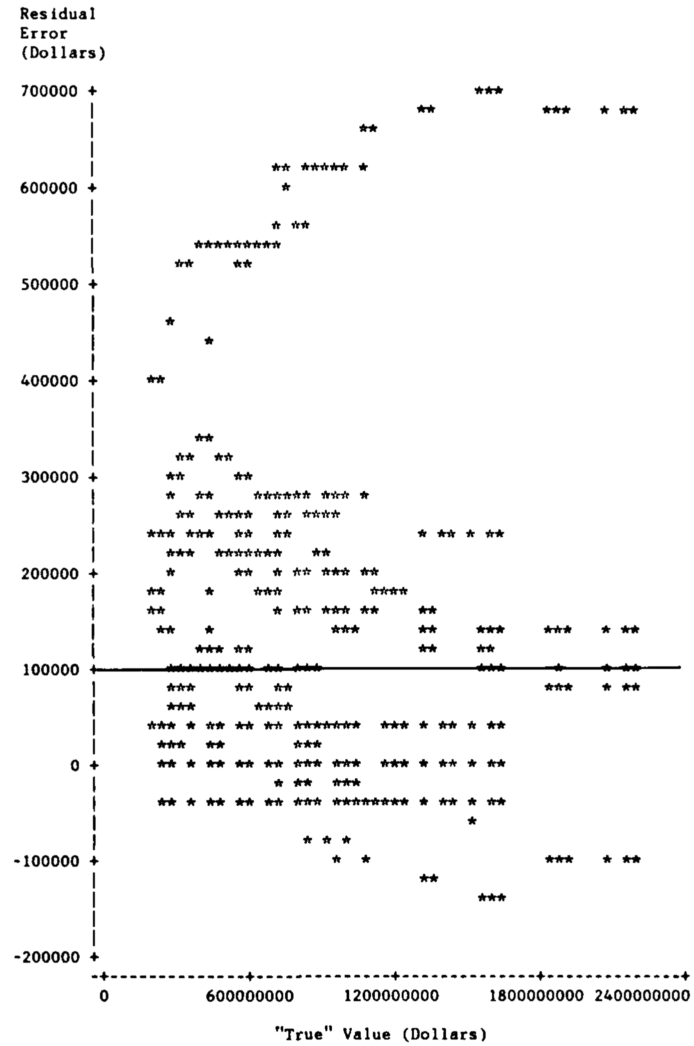


Fig. 8b -- Residual error vs "true" total gross requirements for the F100 engine alternative peacetime programs

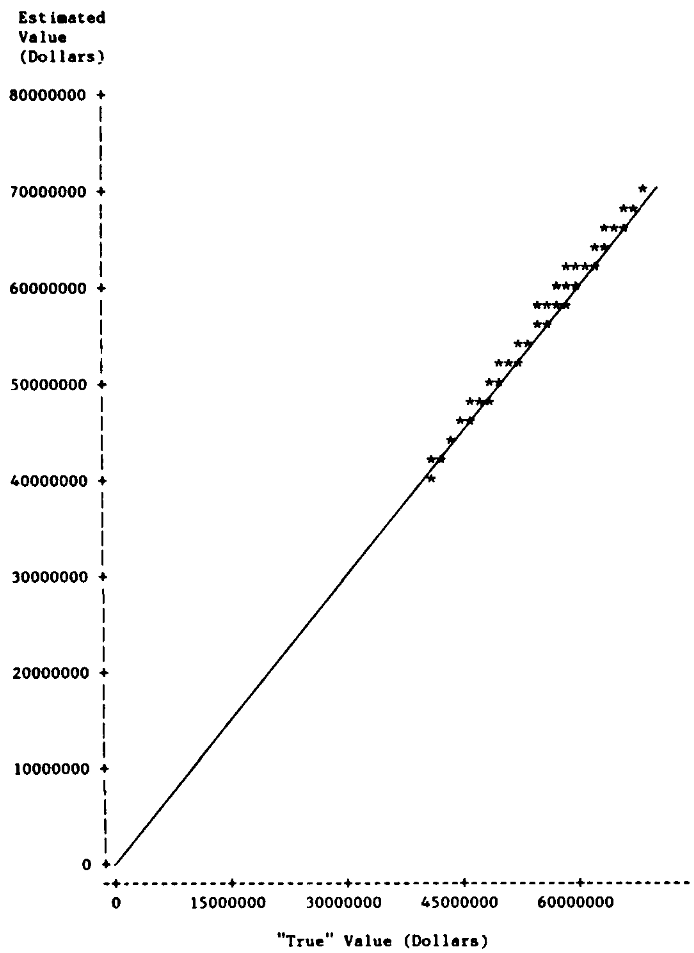


Fig. 8c -- Estimated vs "true" applied serviceable assets for the F100 engine alternative peacetime programs

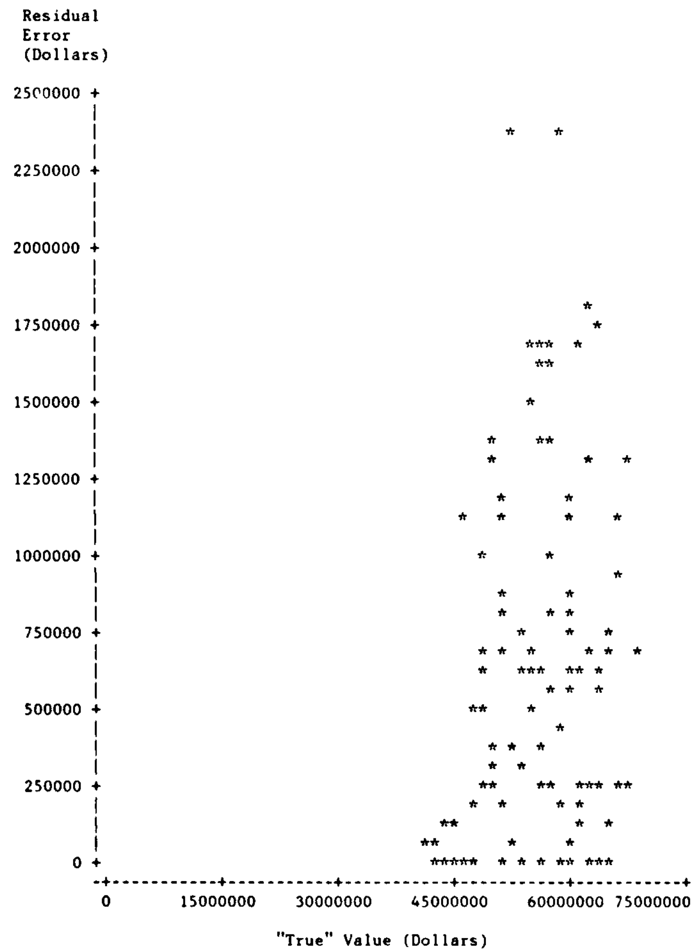


Fig. 8d -- Residual error vs "true" applied servicable assets for the F100 engine alternative peacetime programs

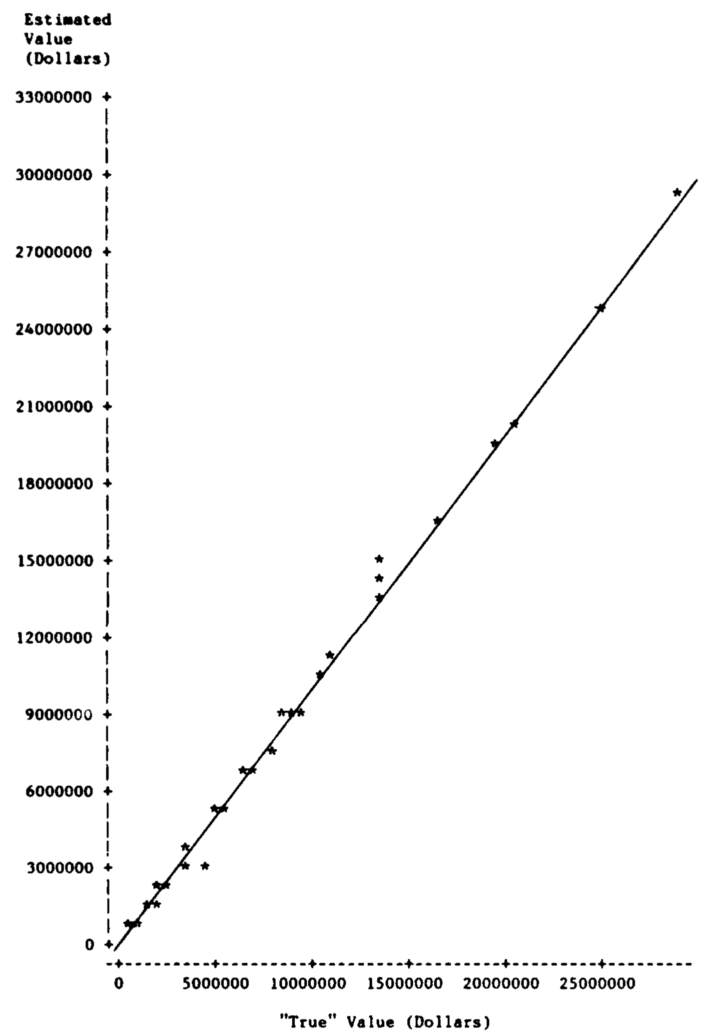


Fig. 8e -- Estimated vs "true" actual base repairs for the F100 engine alternative peacetime programs

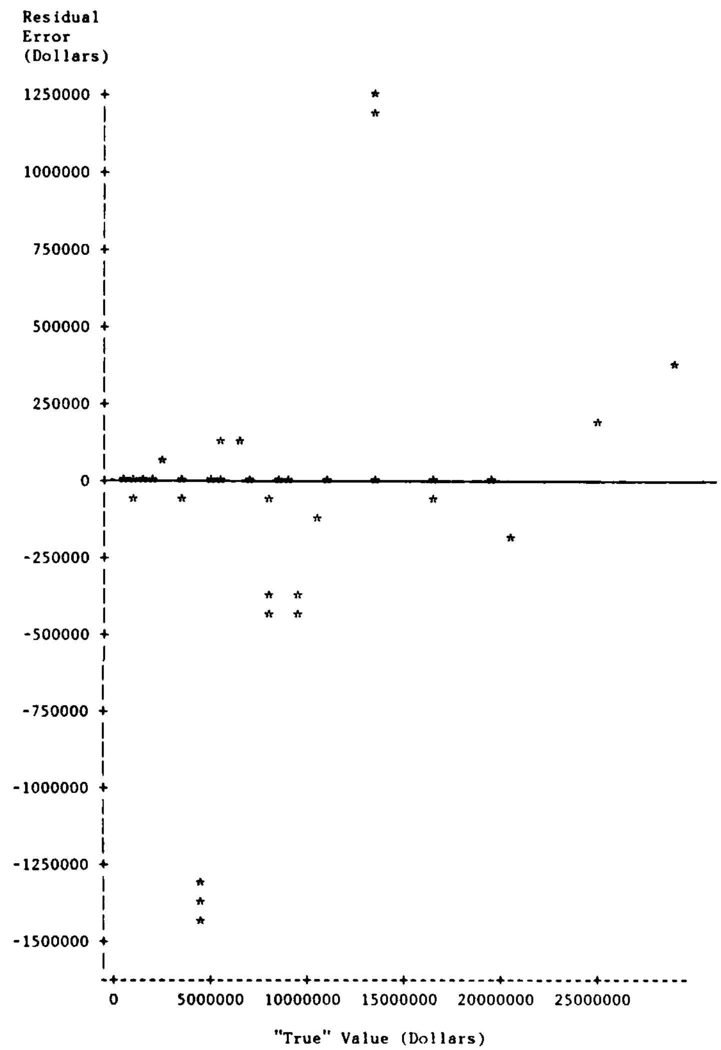


Fig. 8f -- Residual error vs "true" actual base repairs for the F100 engine alternative peacetime programs

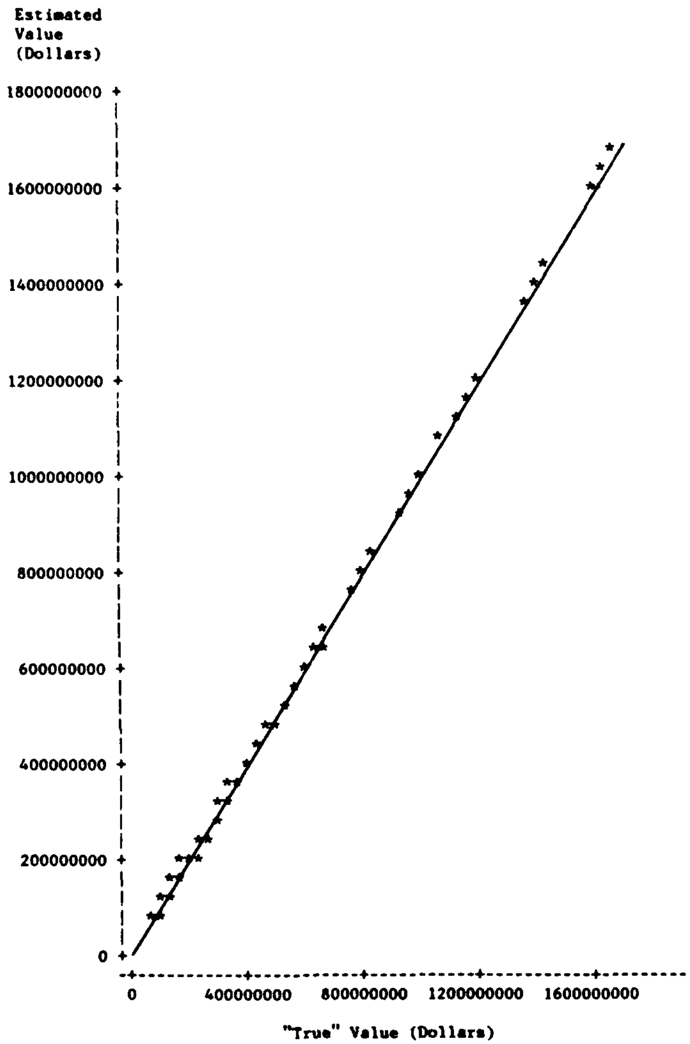


Fig. 8g -- Estimated vs "true" actual depot repairs (valued at purchase price) for the F100 engine alternative peacetime programs

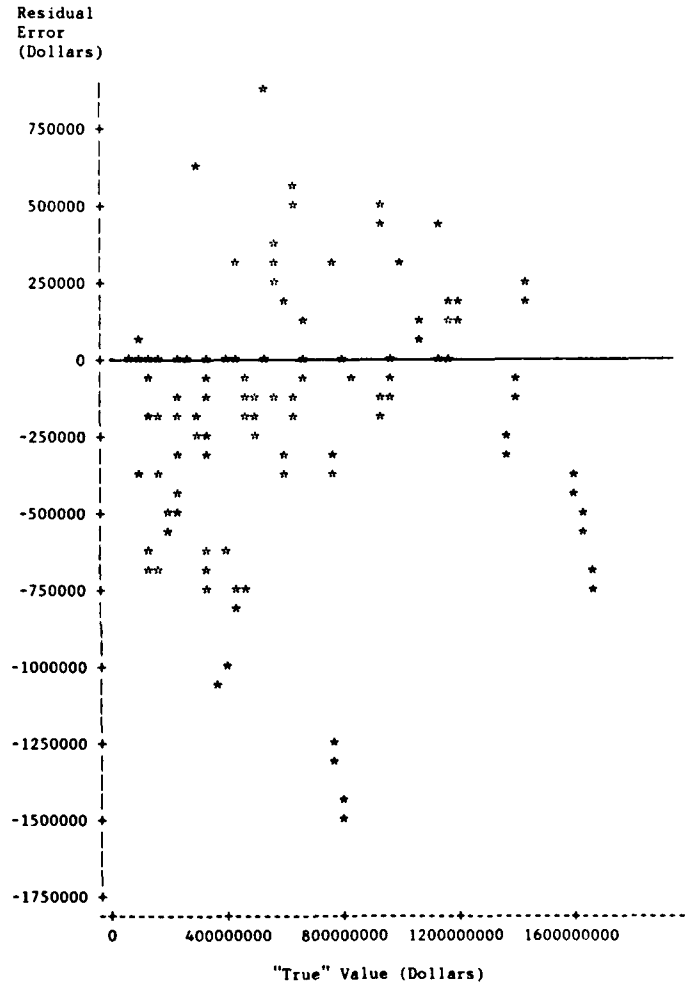


Fig. 8h -- Residual error vs "true" actual depot repairs (valued at purchase price) for the F100 engine alternative peacetime programs

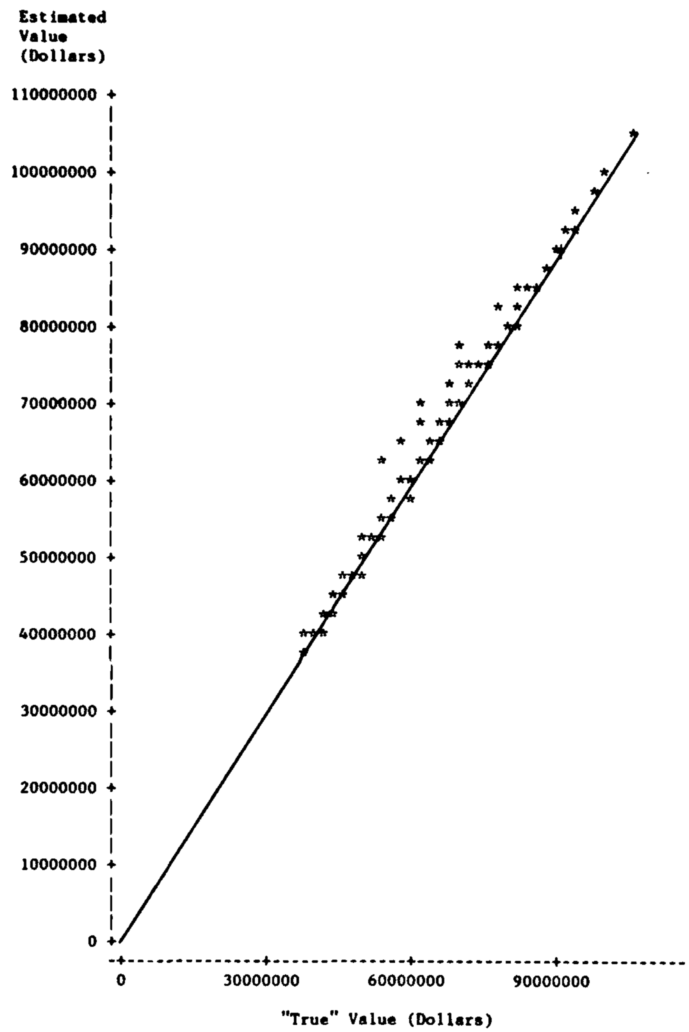


Fig. 8i -- Estimated vs "true" applied due-in and on order assets for the F100 engine alternative peacetime programs

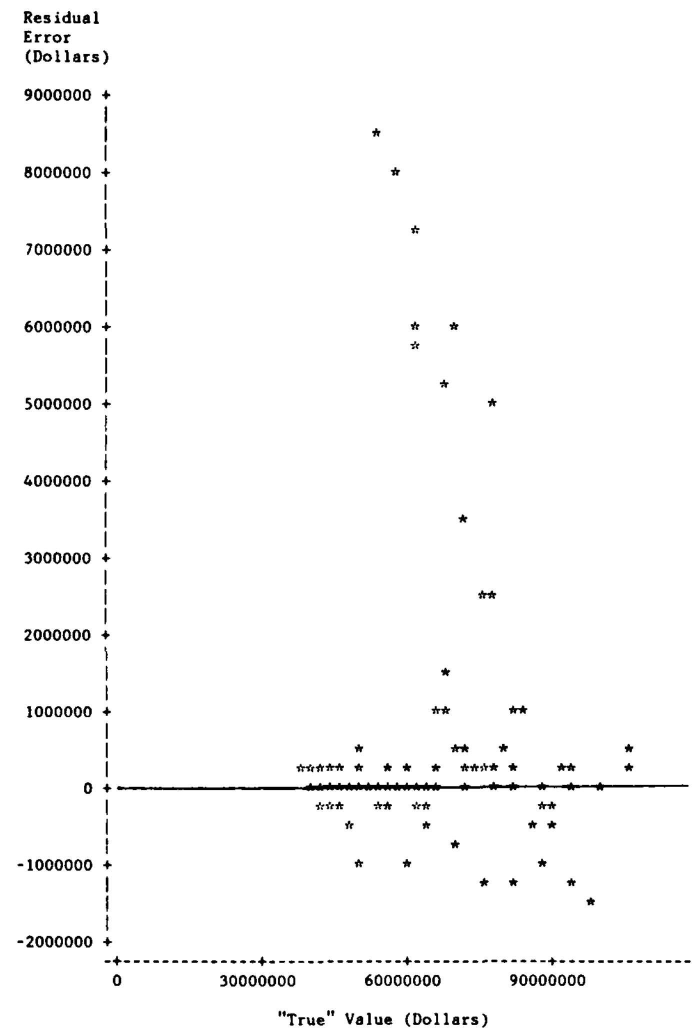


Fig. 8j -- Residual error vs "true" applied due-in and on order assets for the F100 engine alternative peacetime programs

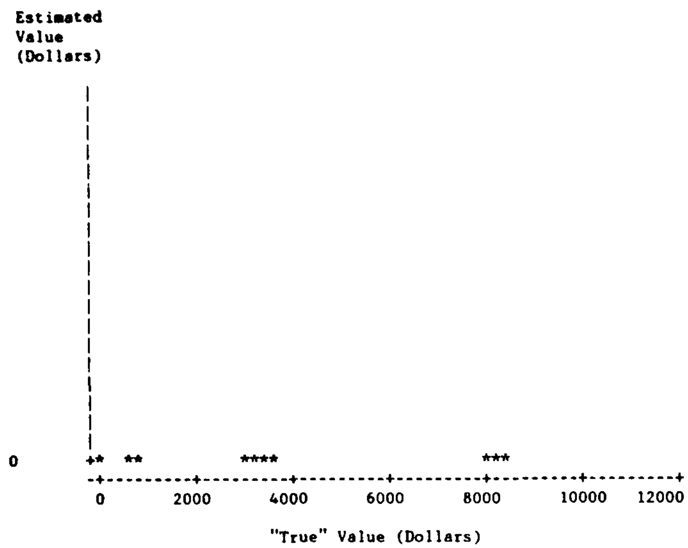


Fig. 8k -- Estimated vs "true" required buy of 0-1 year lead time items for the F100 engine alternative peacetime programs

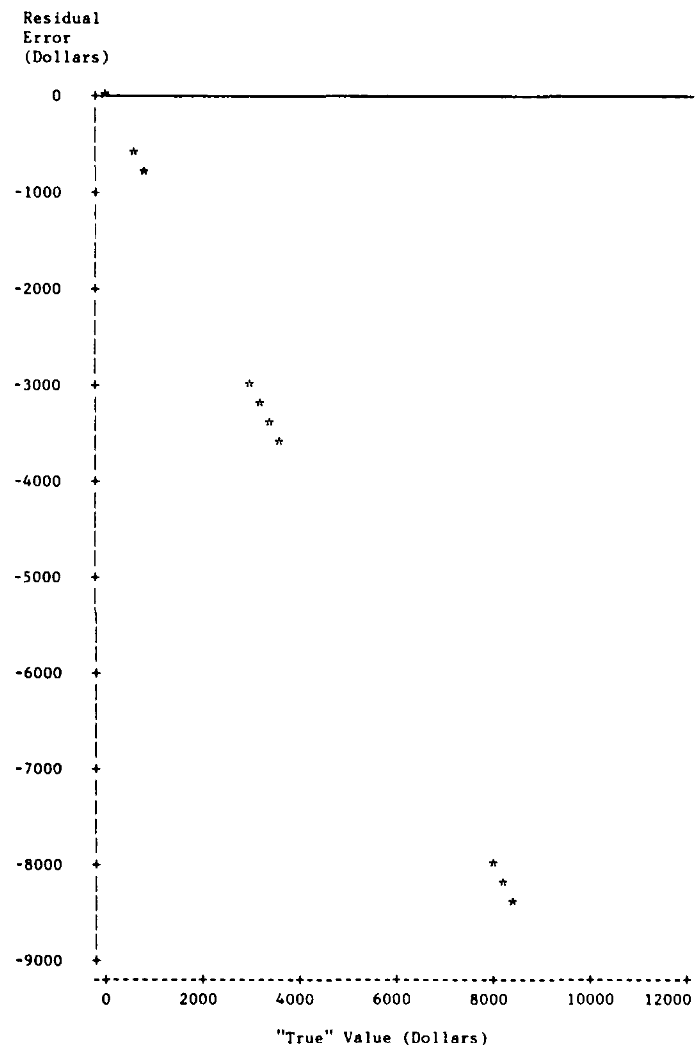


Fig. 8m -- Residual error vs "true" required buy of 0-1 year lead time items for the F100 engine alternative peacetime programs

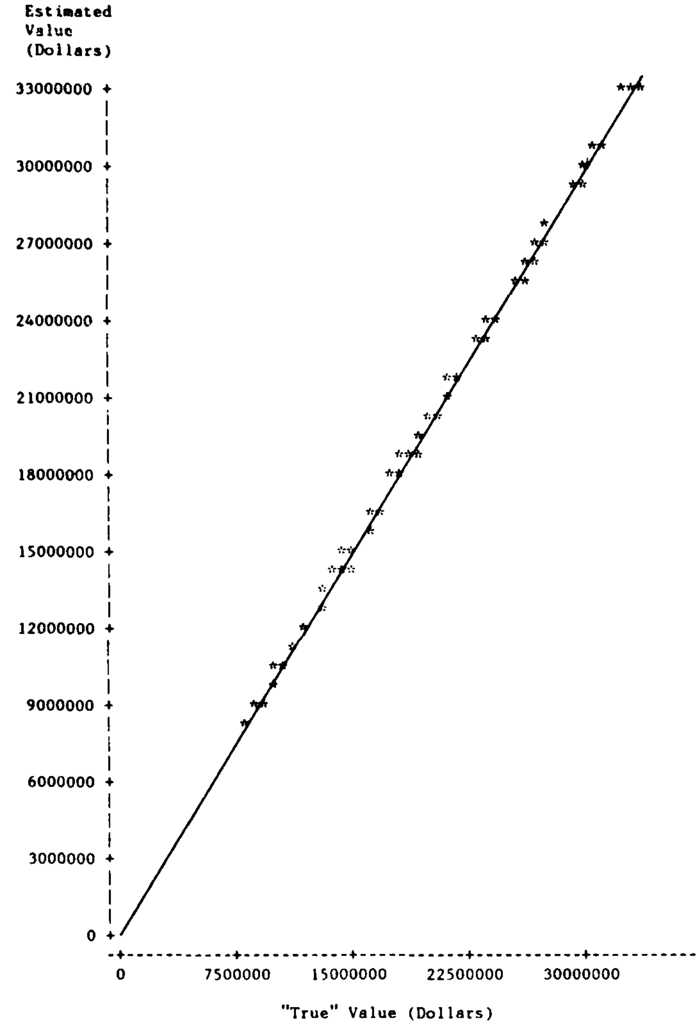


Fig. 8n -- Estimated vs "true" required buy of 1-2 year lead time items for the F100 engine alternative peacetime programs

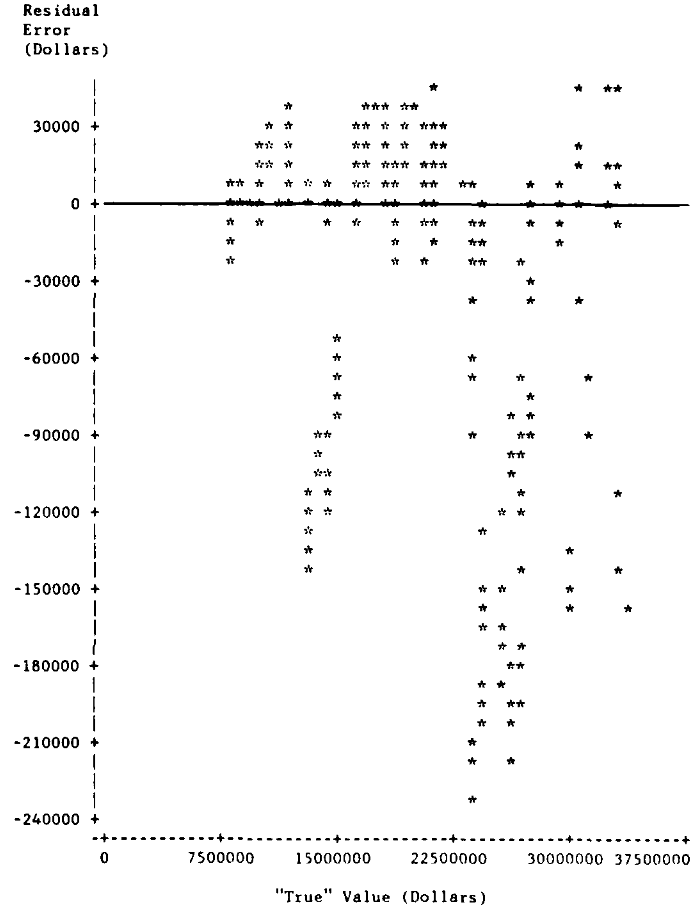


Fig. 8o -- Residual error vs "true" required buy of 1-2 year lead time items for the F100 engine alternative peacetime programs

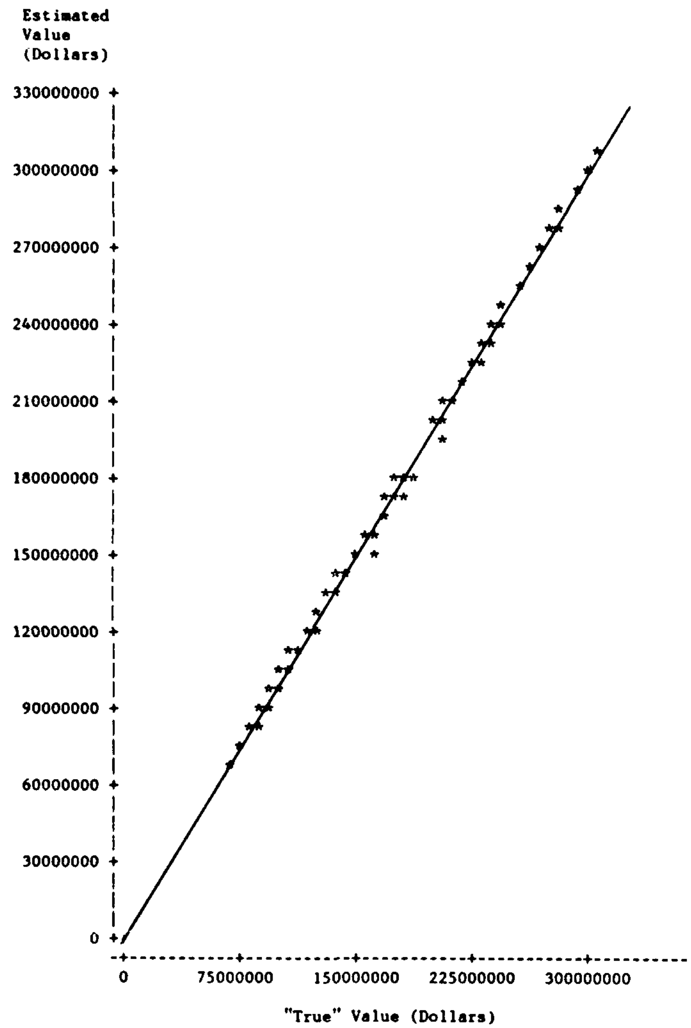


Fig. 8p -- Estimated vs "true" required buy of 2-3 year lead time items for the F100 engine alternative peacetime programs

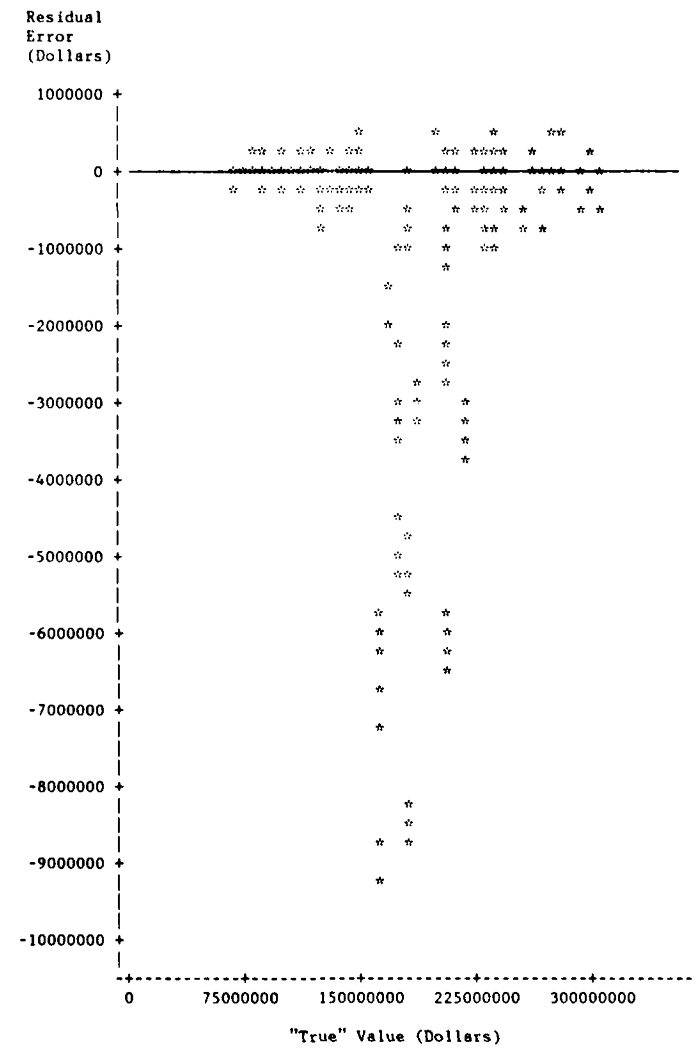


Fig. 8q -- Residual error vs "true" required buy of 2-3 year lead time items for the F100 engine alternative peacetime programs

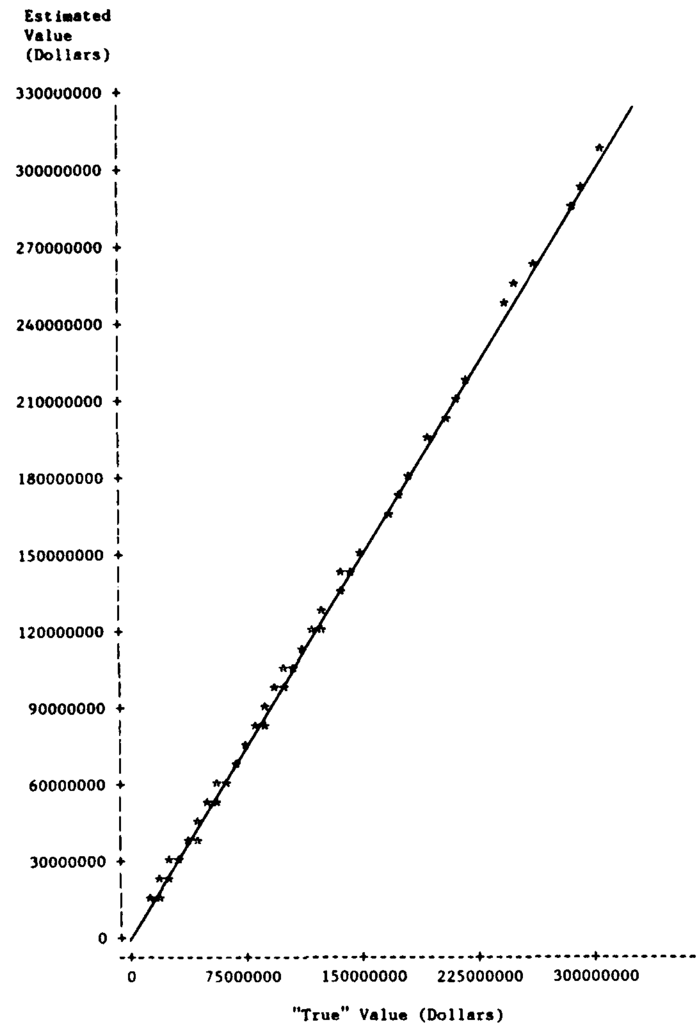


Fig. 8r -- Estimated vs "true" actual depot repairs (valued at repair cost) for the F100 engine alternative peacetime programs

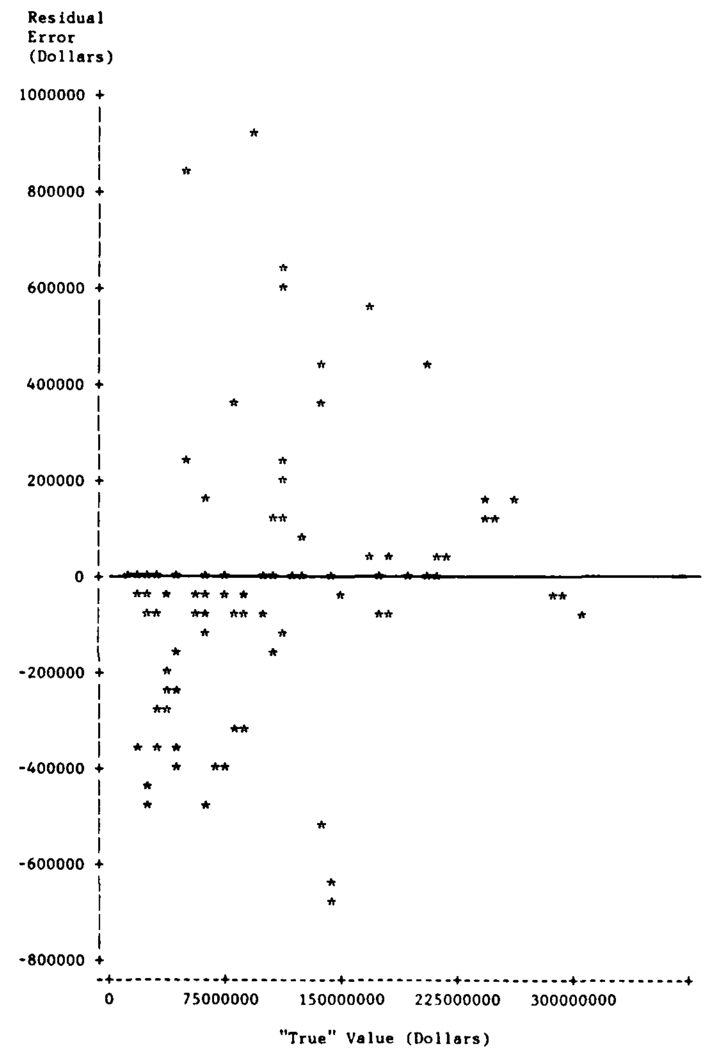


Fig. 8s -- Residual error vs "true" actual depot repairs (valued at repair cost) for the F100 engine alternative peacetime programs

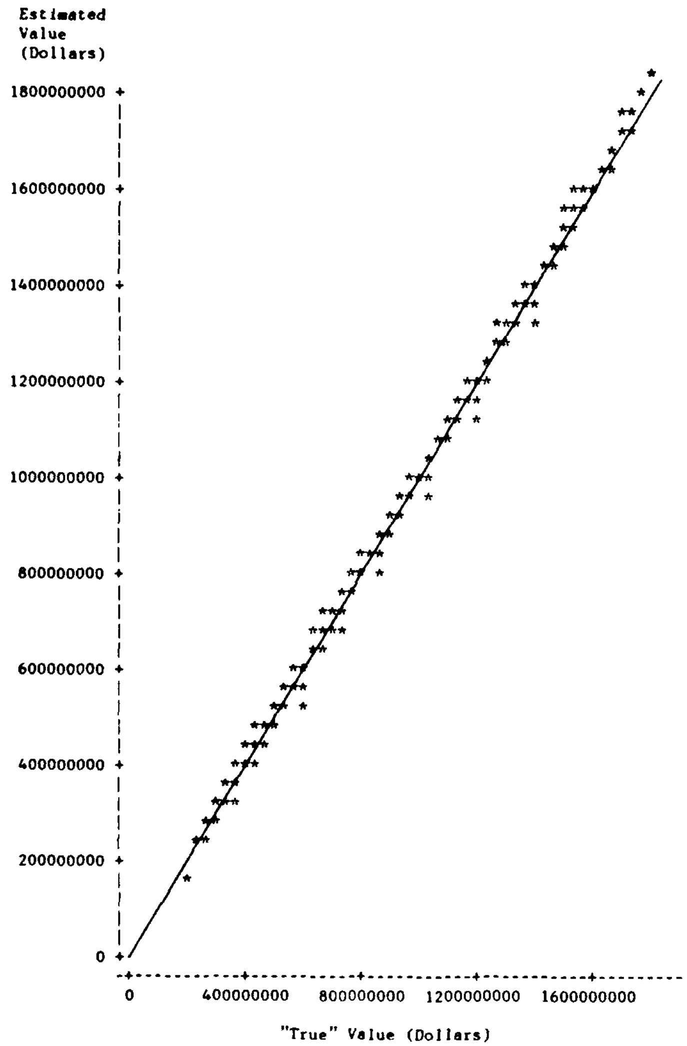


Fig. 8aa -- Estimated vs "true" total gross requirements for the F100 engine alternative wartime programs

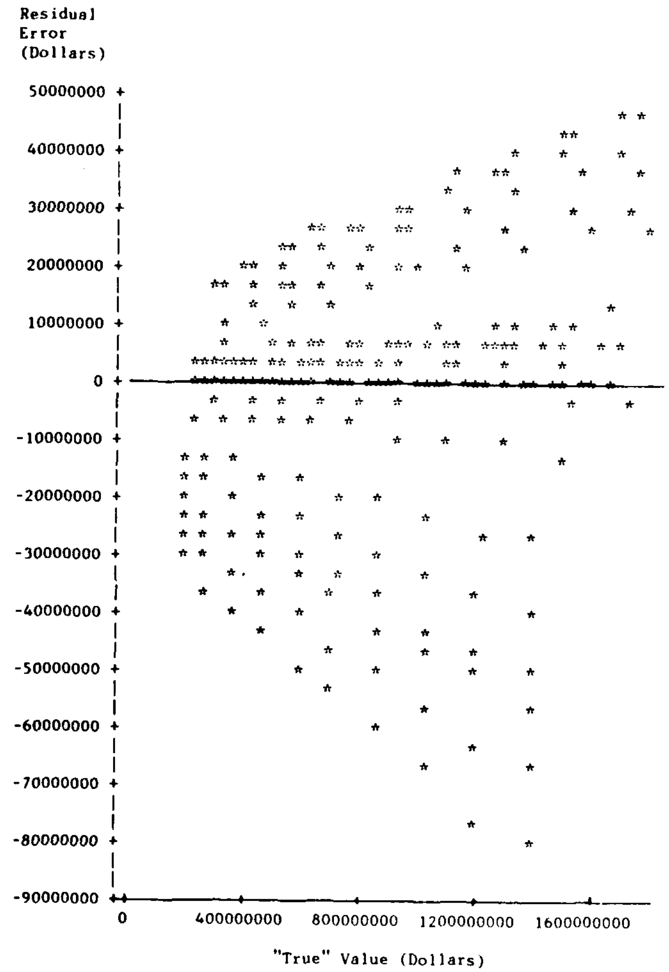
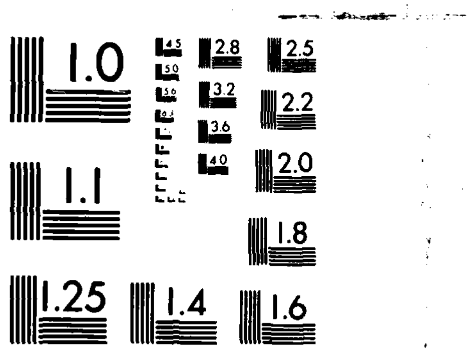


Fig. 8bb -- Residual error vs "true" total gross requirements for the F100 engine alternative wartime programs

AD-A152 014   MANAGING RECOVERABLE AIRCRAFT COMPONENTS IN THE PPB   4/5
(PLANNING PROGRAMMING..(U) RAND CORP SANTA MONICA CA
J BIGELOW JUN 84 RAND/R-3094-MIL MDA903-81-C-0381

UNCLASSIFIED   F/G 5/1   NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A

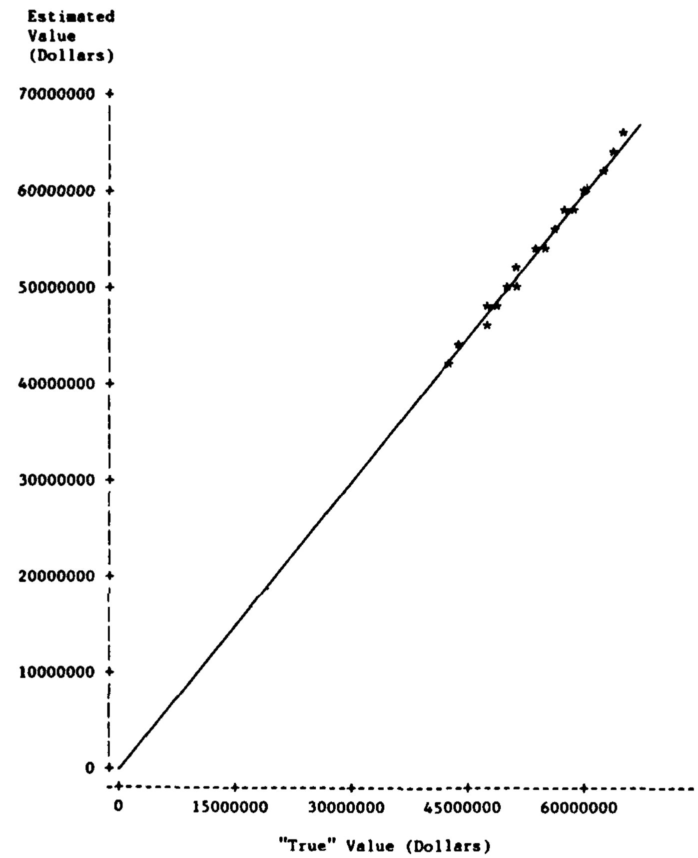


Fig. 8cc -- Estimated vs "true" applied serviceable assets for the F100 engine alternative wartime programs

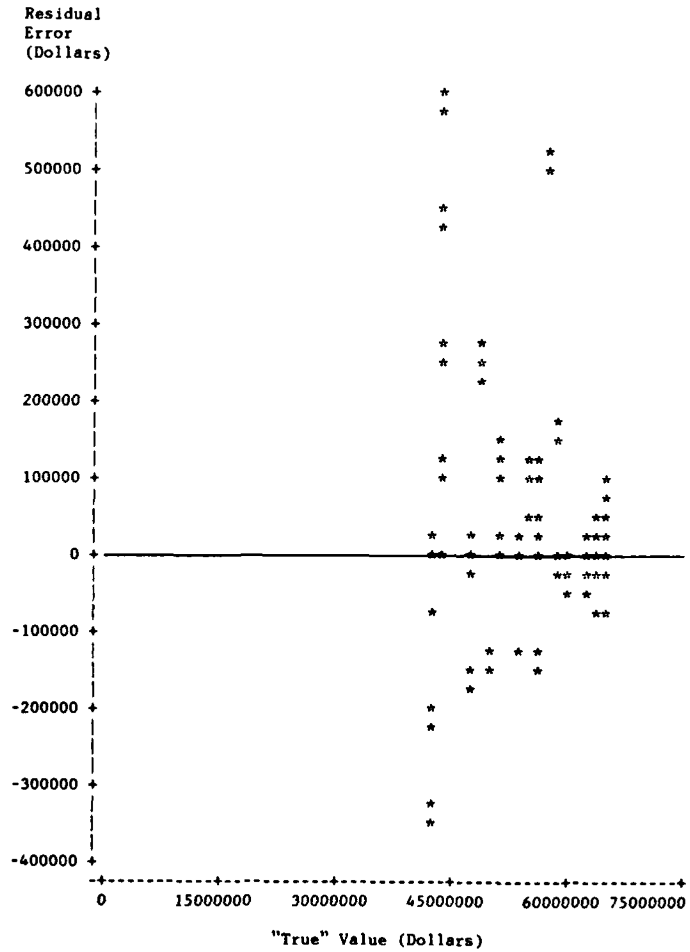


Fig. 8dd -- Residual error vs "true" applied serviceable assets for the F100 engine alternative wartime programs

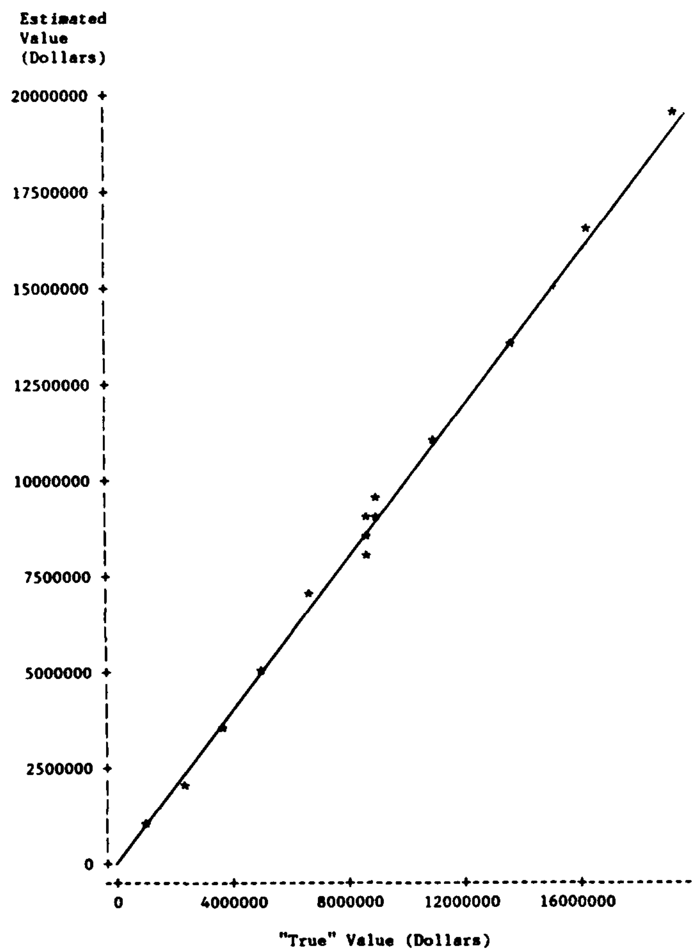


Fig. 8ee -- Estimated vs "true" actual base repairs for the F100 engine alternative wartime programs

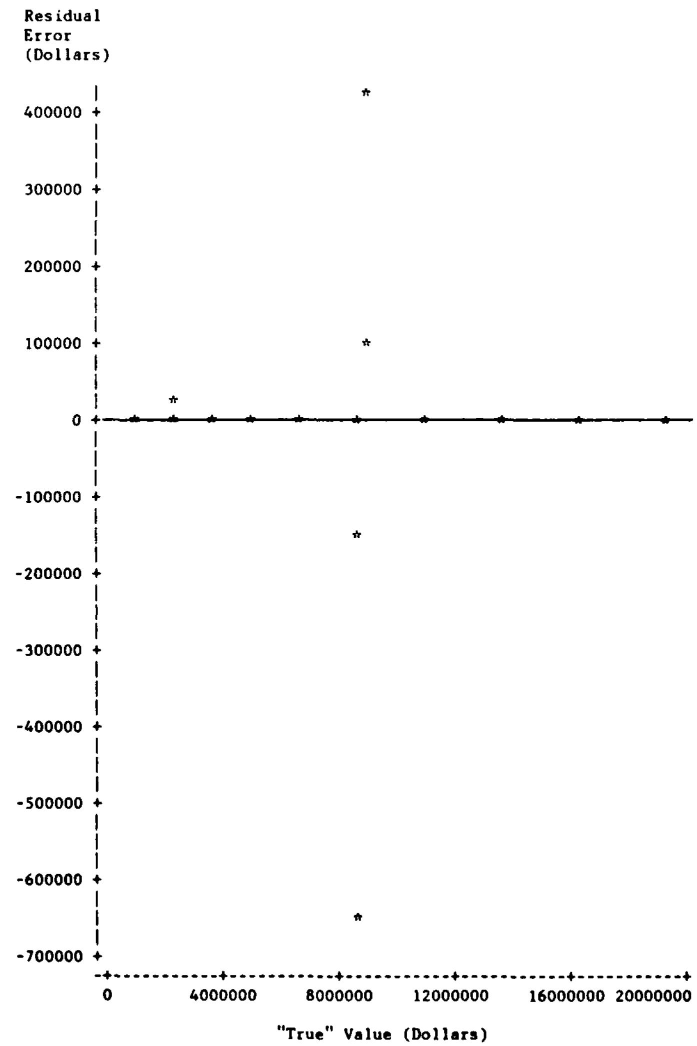


Fig. 8ff -- Residual error vs "true" actual base repairs for the F100 engine alternative wartime programs

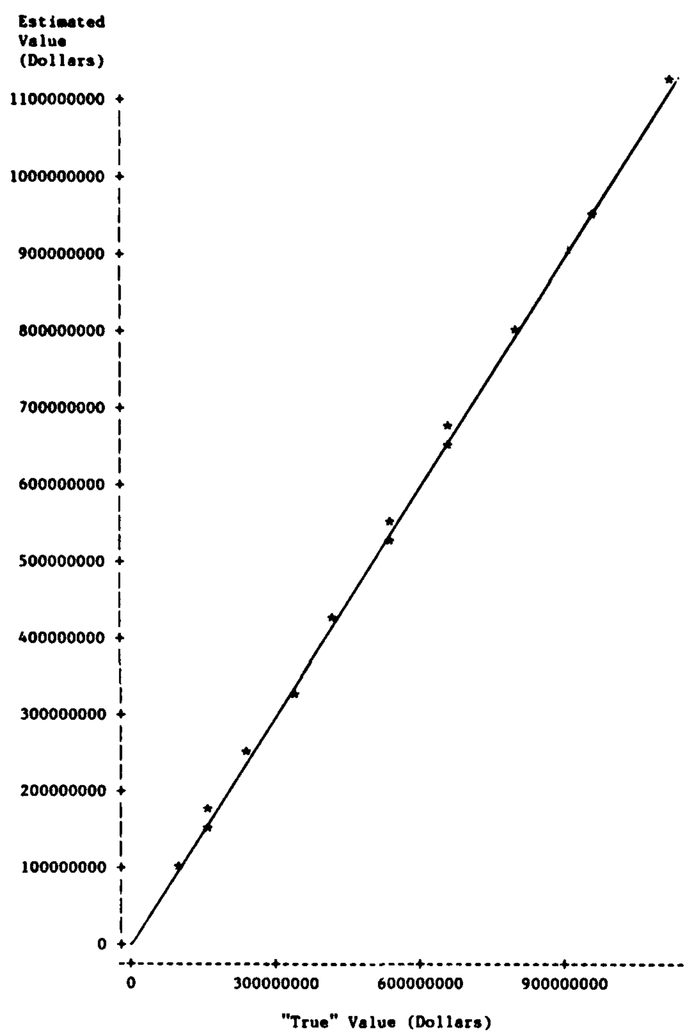


Fig. 8gg -- Estimated vs "true" actual depot repairs (valued at purchase price) for the F100 engine alternative wartime programs

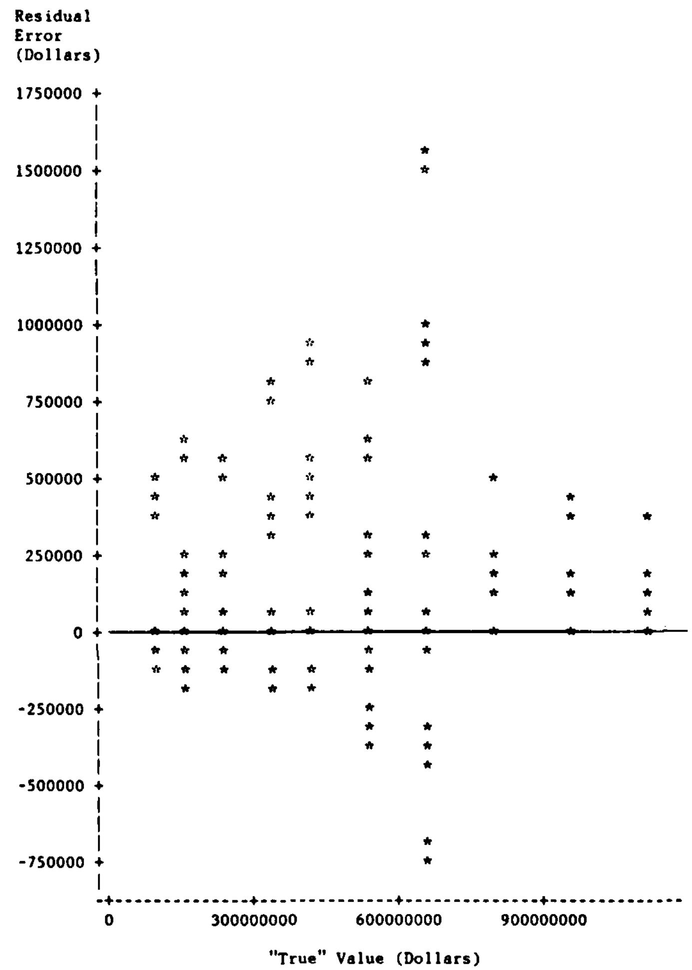


Fig. 8hh -- Residual error vs "true" actual depot repairs (valued at purchase price) for the F100 engine alternative wartime programs

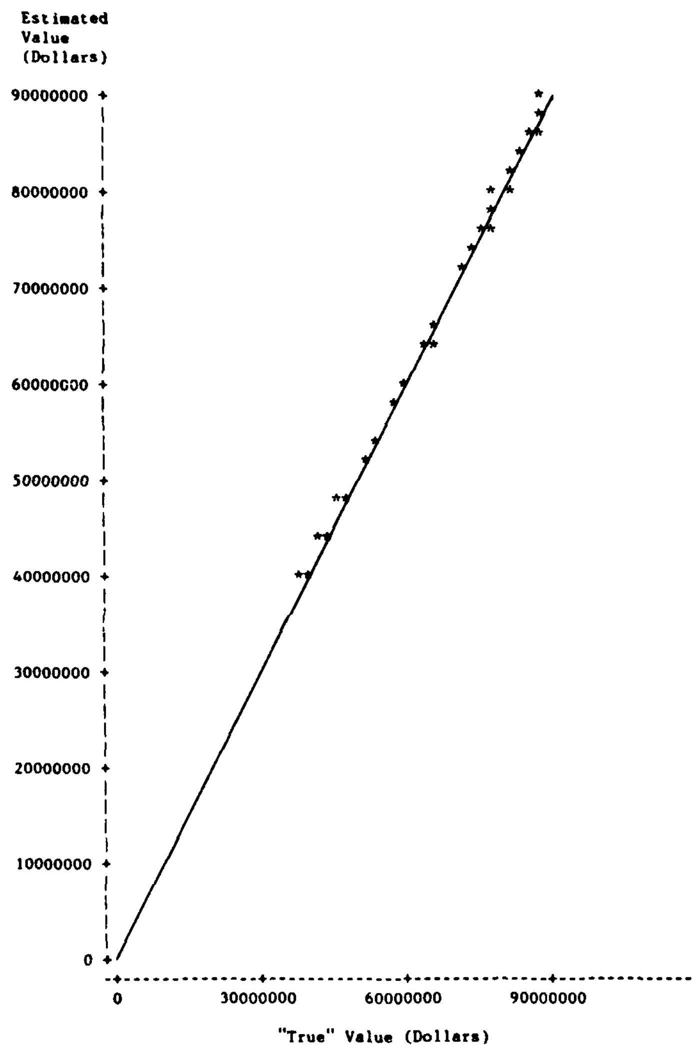


Fig. 8ii -- Estimated vs "true" applied due-in and on order assets for the F100 engine alternative wartime programs

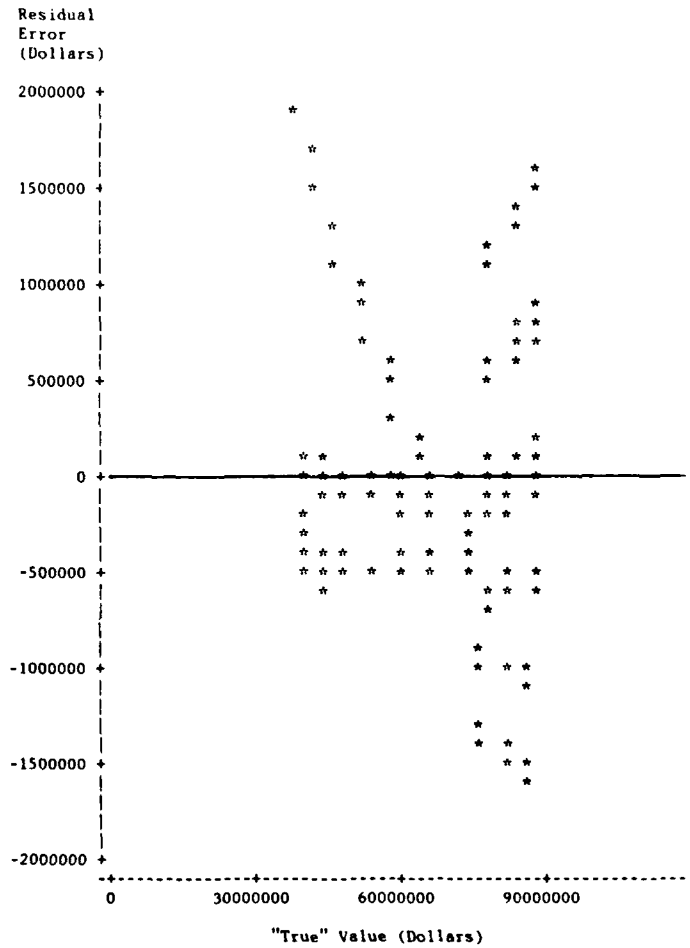


Fig. 8jj -- Residual error vs "true" applied due-in and on order assets for the F100 engine alternative wartime programs

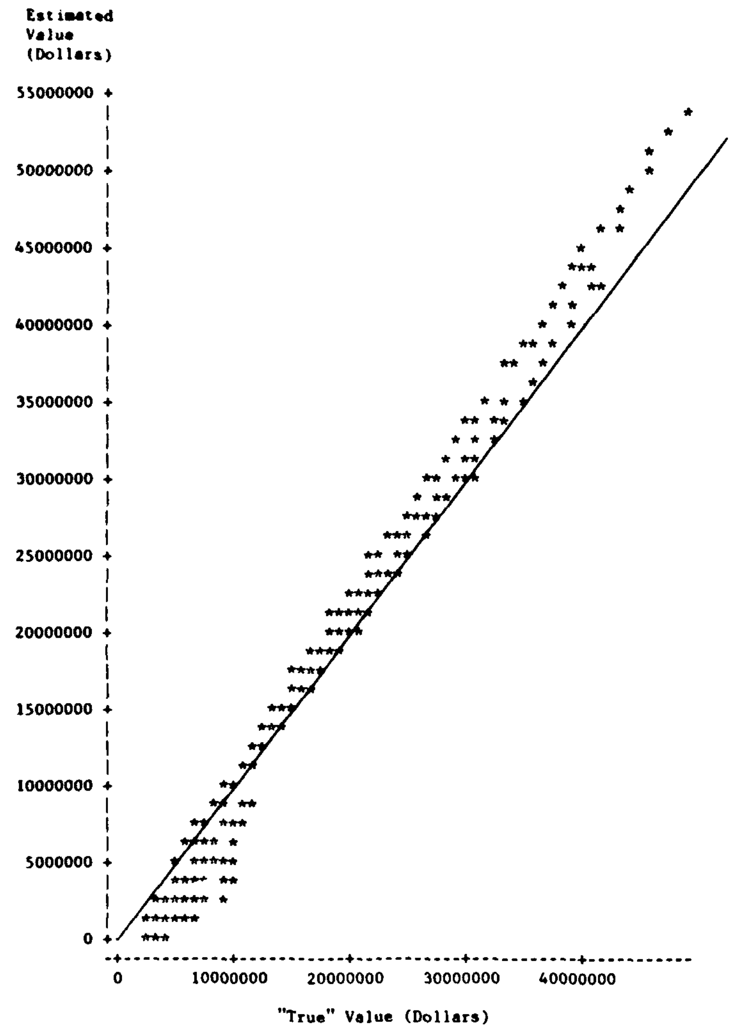


Fig. 8nn -- Estimated vs "true" required buy of 1-2 year lead time items for the F100 engine alternative wartime programs

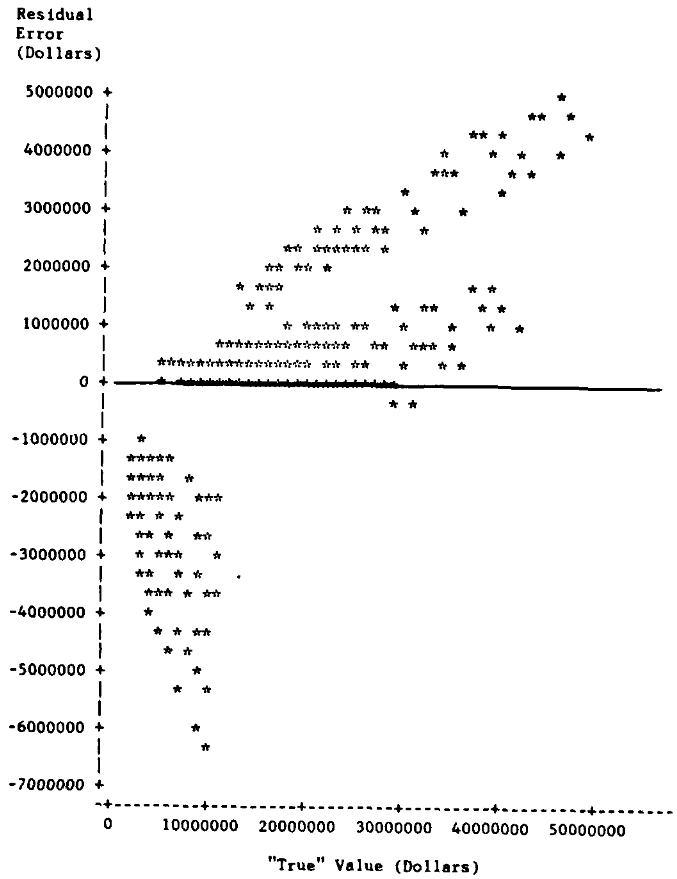


Fig. 8oo -- Residual error vs "true" required buy of 1-2 year lead time items for the F100 engine alternative wartime programs

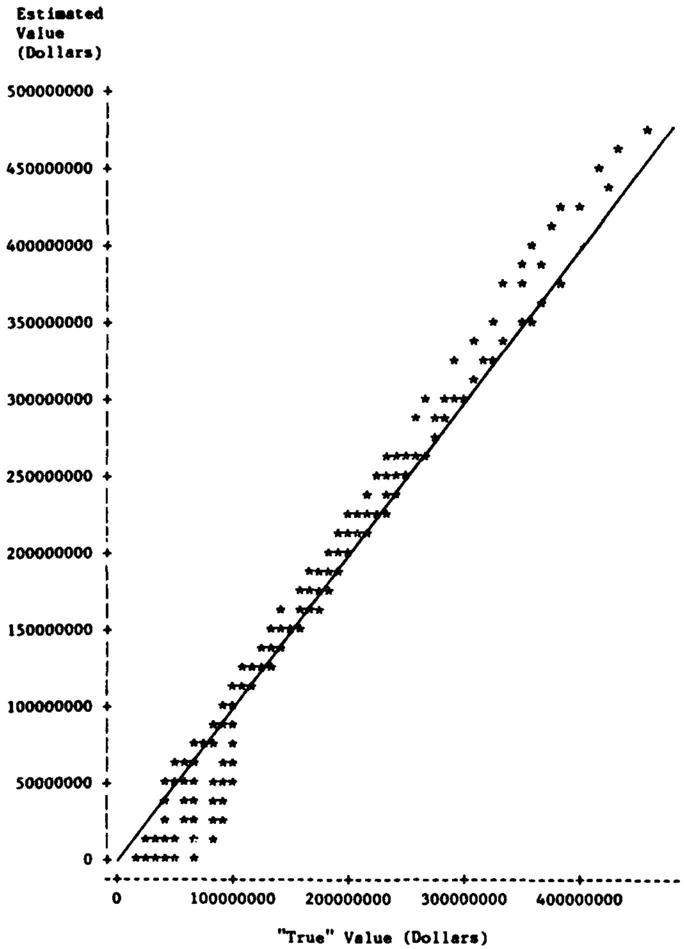


Fig. 8pp -- Estimated vs "true" required buy of 2-3 year lead time items for the F100 engine alternative wartime programs

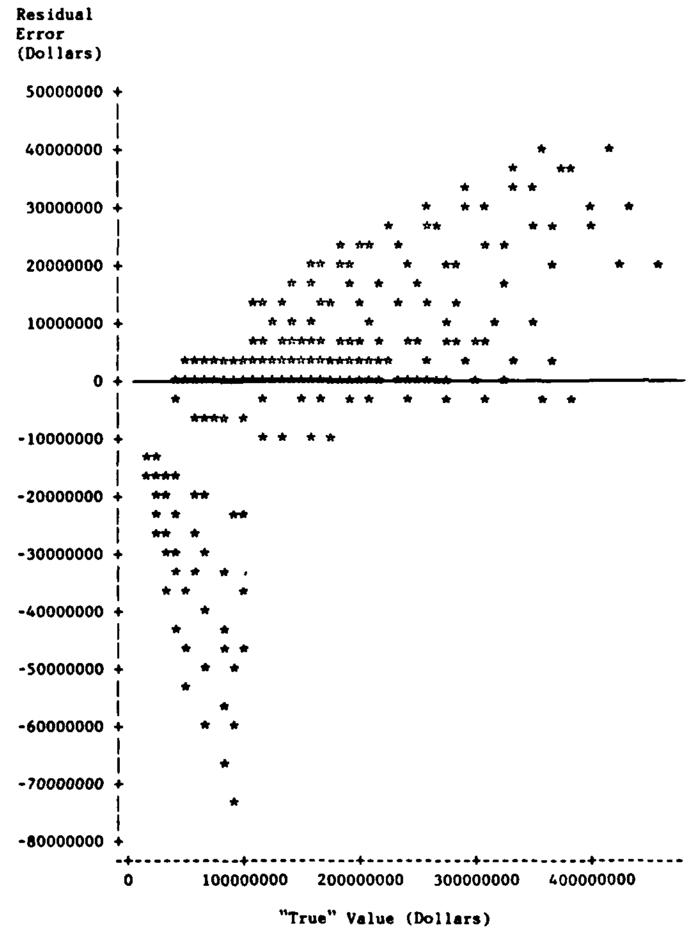


Fig. 8qq -- Residual error vs "true" required buy of 2-3 year lead time items for the F100 engine alternative wartime programs

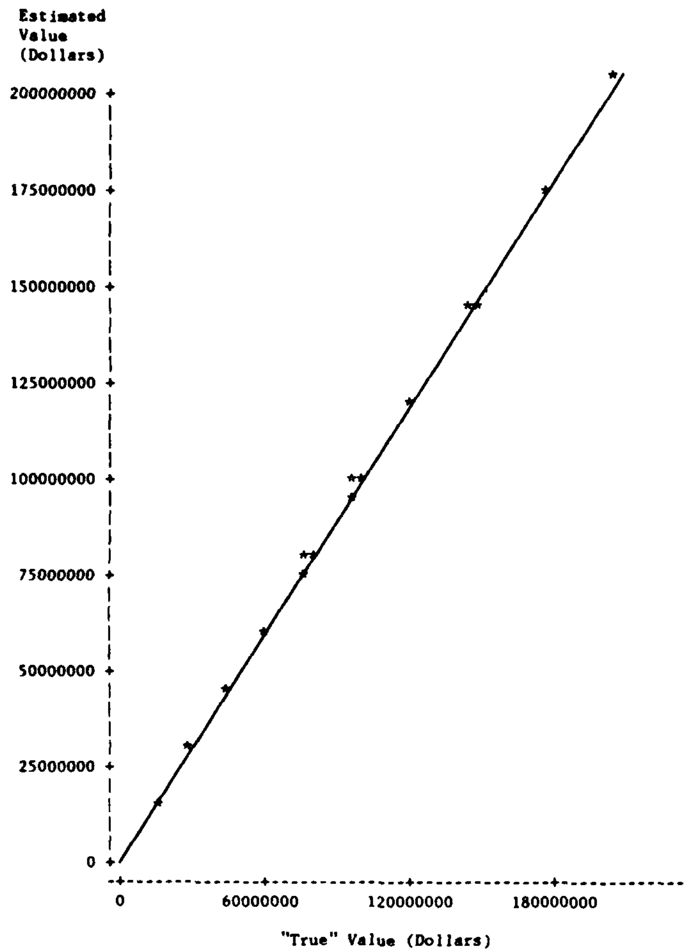


Fig. 8rr -- Estimated vs "true" actual depot repairs (valued at repair cost) for the F100 engine alternative wartime programs

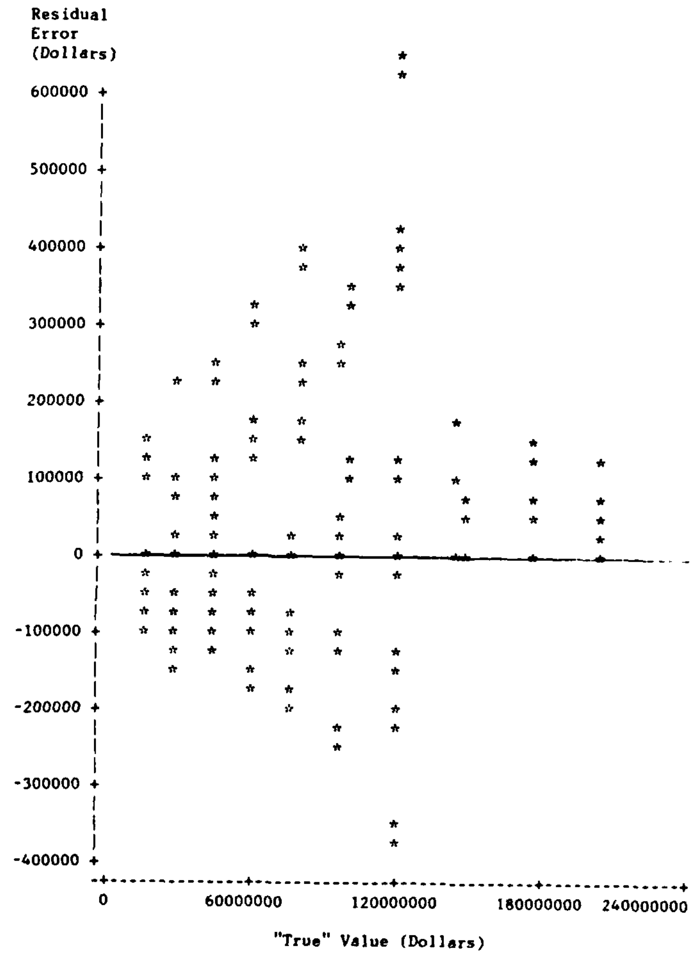


Fig. 8ss -- Residual error vs "true" actual depot repairs (valued at repair cost) for the F100 engine alternative wartime programs

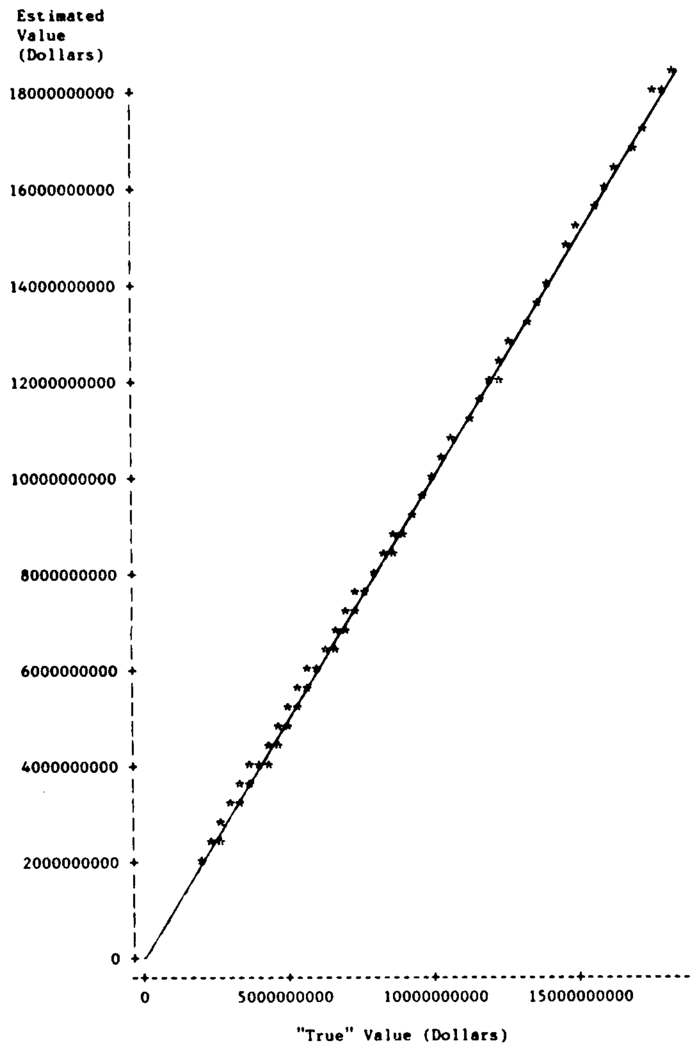


Fig. 9a -- Estimated vs "true" gross requirements for the F004 aircraft alternative peacetime programs

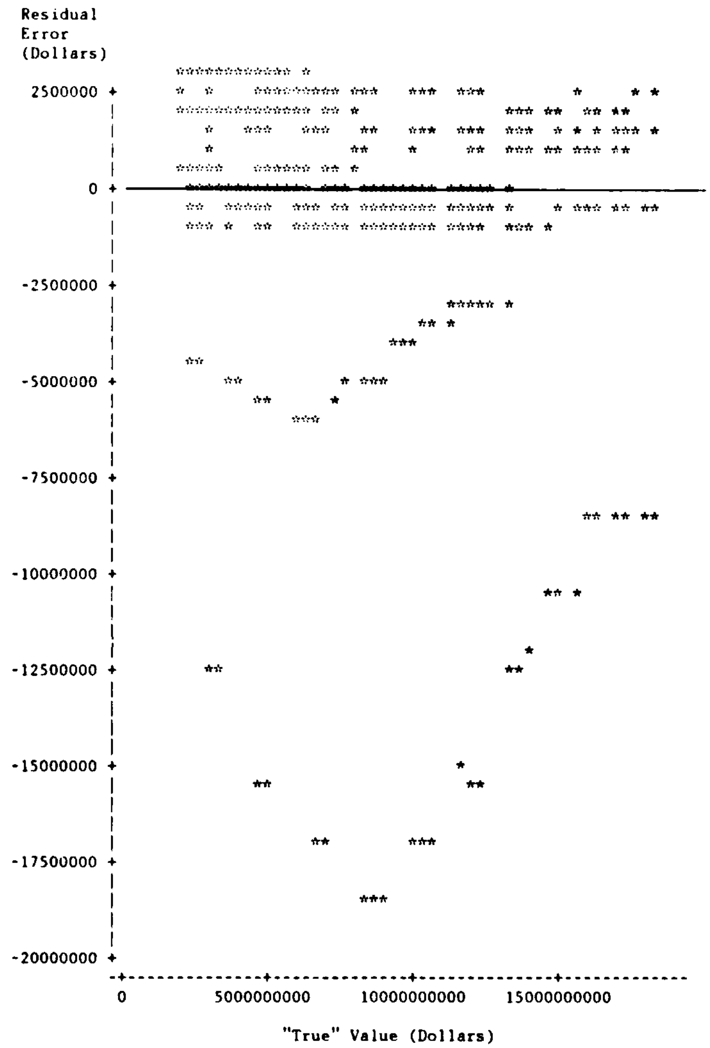


Fig. 9b -- Residual error vs "true" total gross requirements for the F004 aircraft alternative peacetime programs

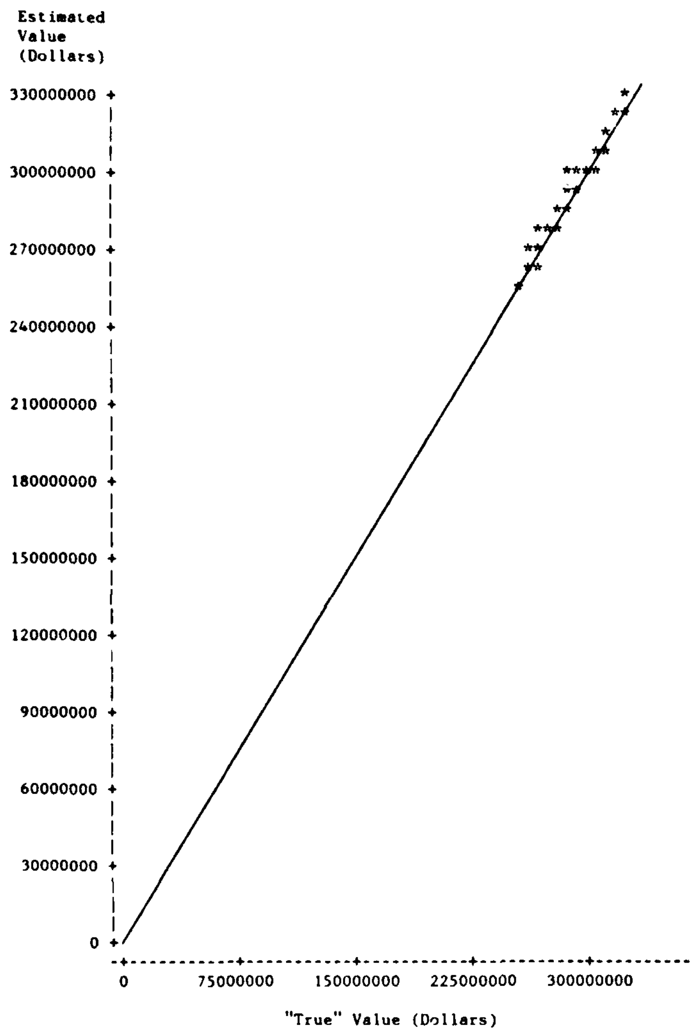


Fig. 9c -- Estimated vs "true" applied serviceable assets for the F004 aircraft alternative peacetime programs

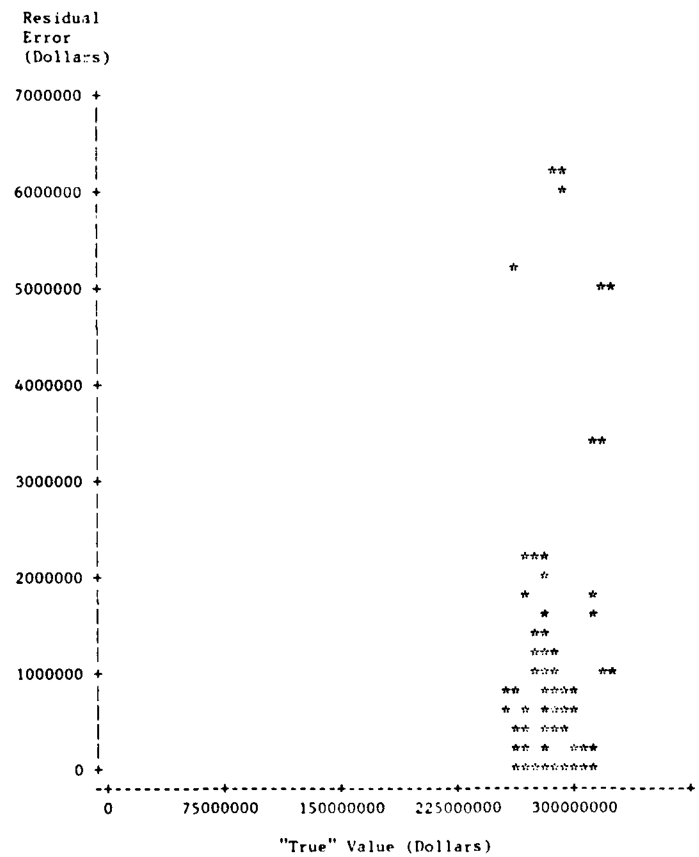


Fig. 9d -- Residual error vs "true" applied serviceable assets for the F004 aircraft alternative peacetime programs

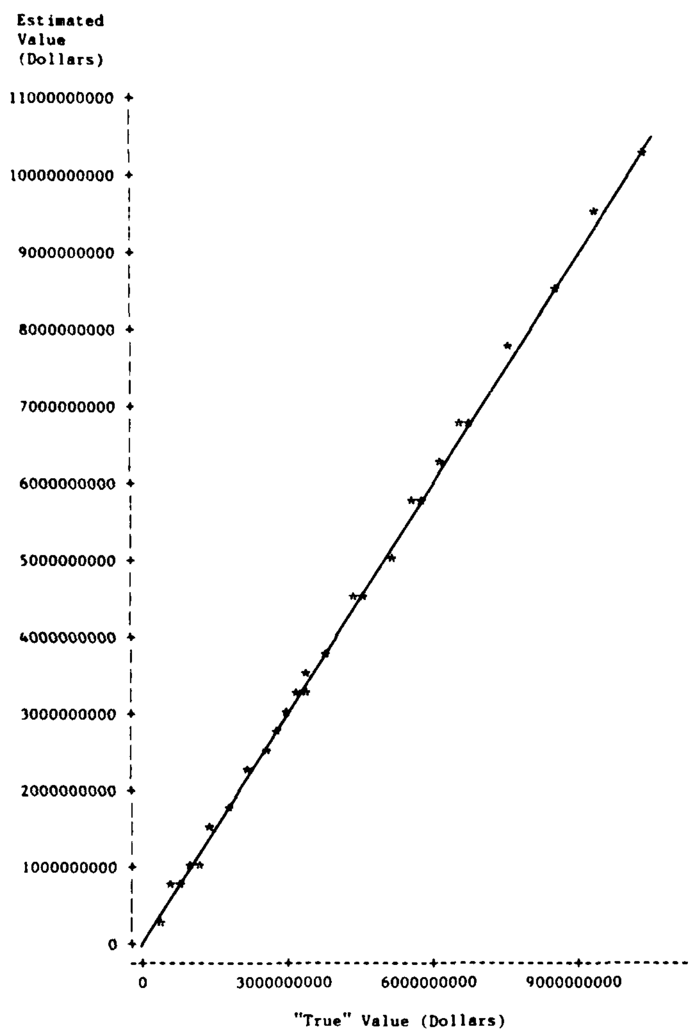


Fig. 9e -- Estimated vs "true" actual base repairs for the F004 aircraft alternative peacetime programs

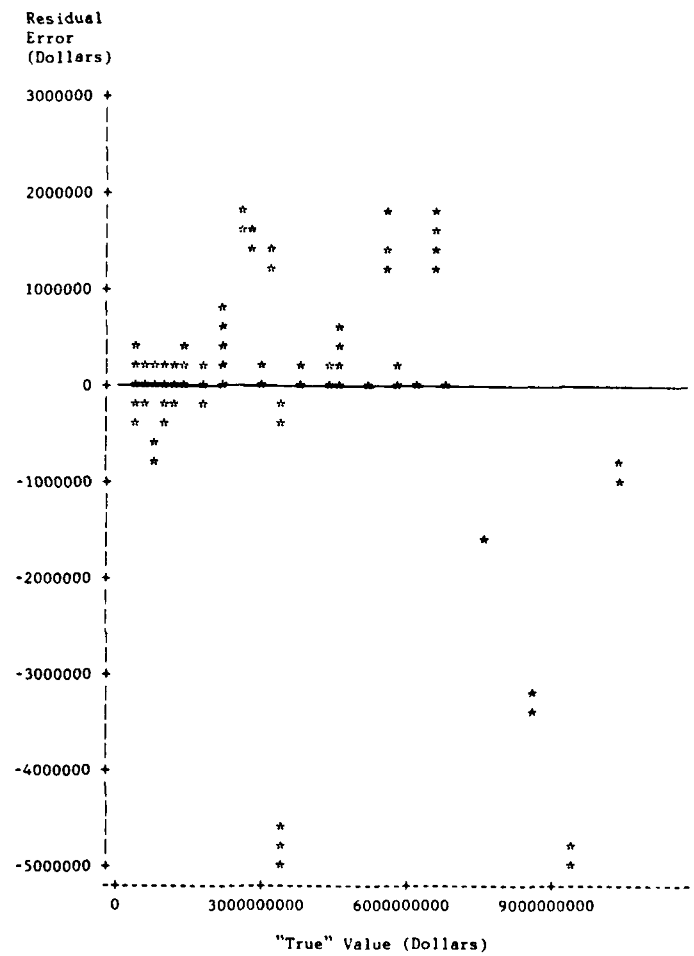


Fig. 9f -- Residual error vs "true" actual base repairs for the F004 aircraft alternative peacetime programs

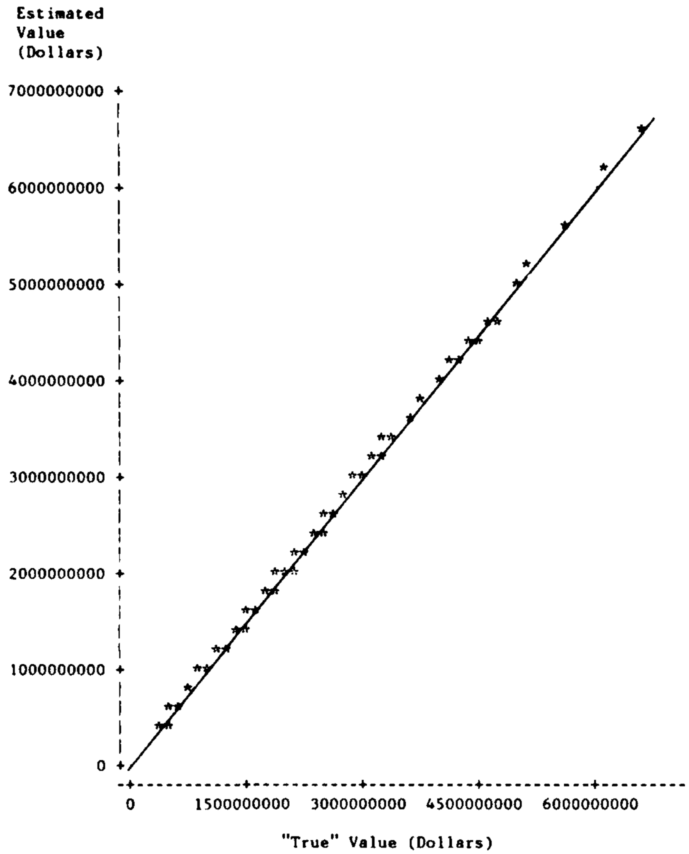


Fig. 9g -- Estimated vs "true" actual depot repairs (valued at purchase price) for the F004 aircraft alternative peacetime programs

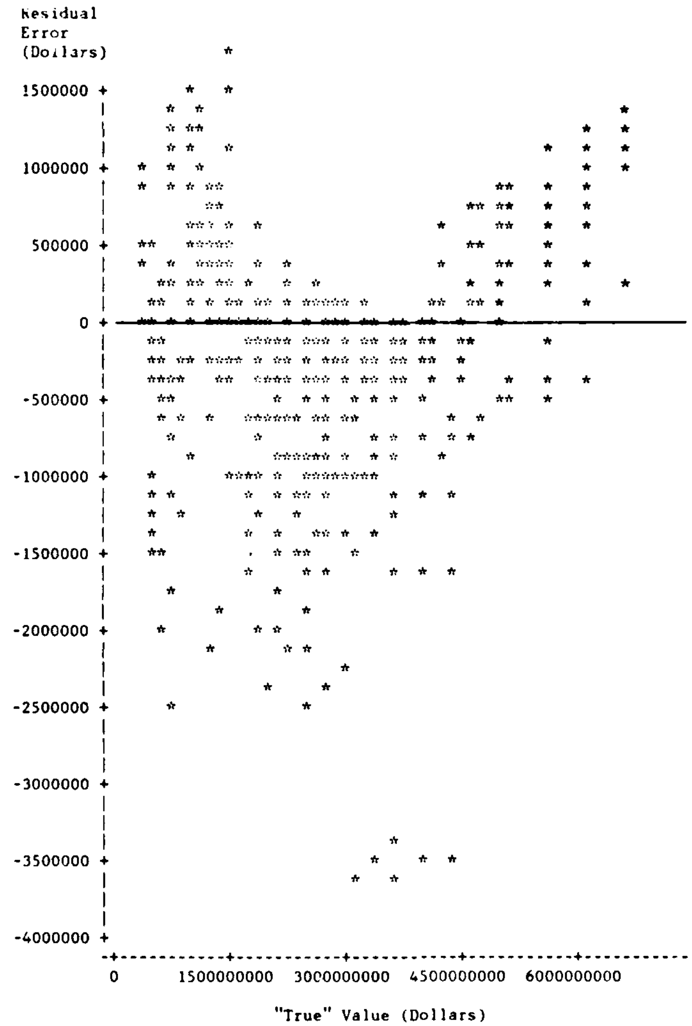


Fig. 9h -- Residual error vs "true" actual depot repairs (valued at purchase price) for the F004 aircraft alternative peacetime programs

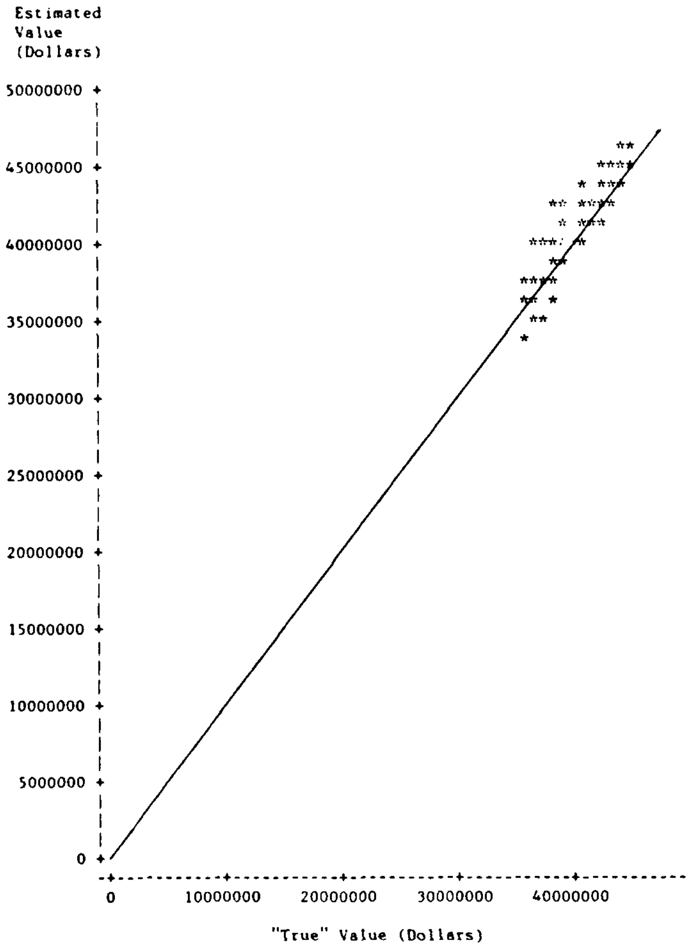


Fig. 9i -- Estimated vs "true" applied due-in and on order assets for the F004 aircraft alternative peacetime programs

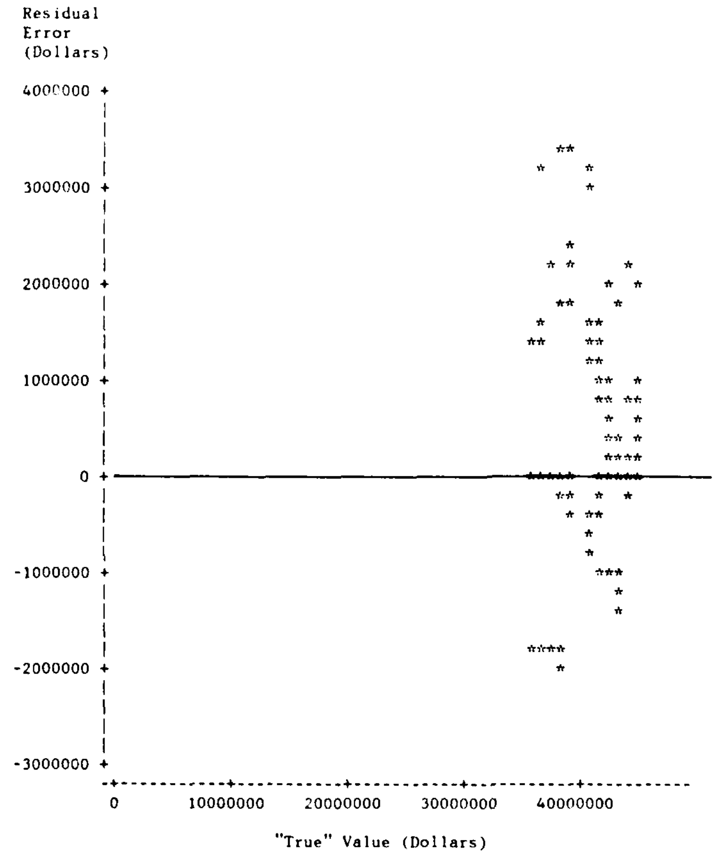


Fig. 9j -- Residual error vs "true" applied due-in and on order assets for the F004 aircraft alternative peacetime programs

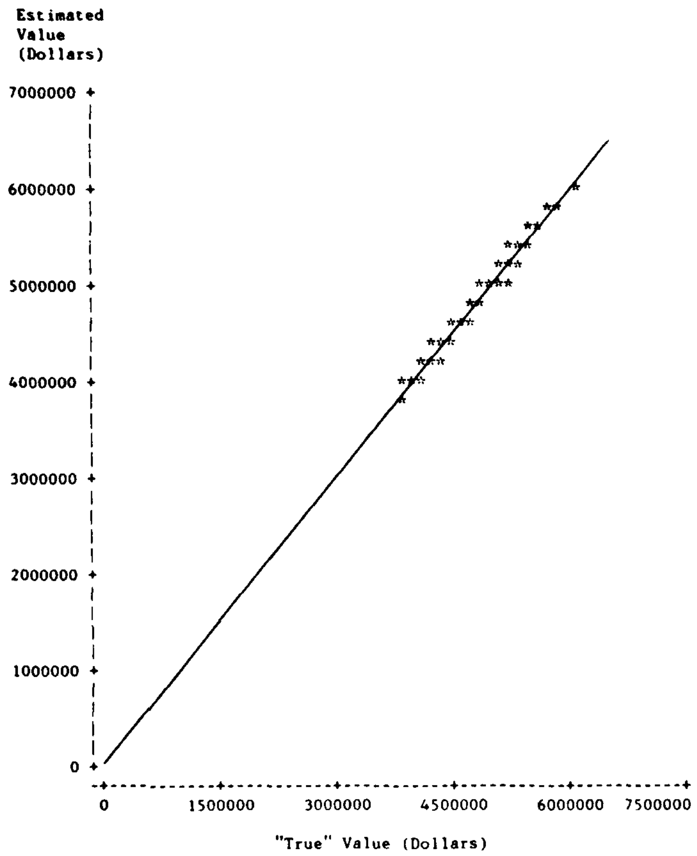


Fig. 9k -- Estimated vs "true" required buy of 0-1 year lead time items for the F004 aircraft alternative peacetime programs

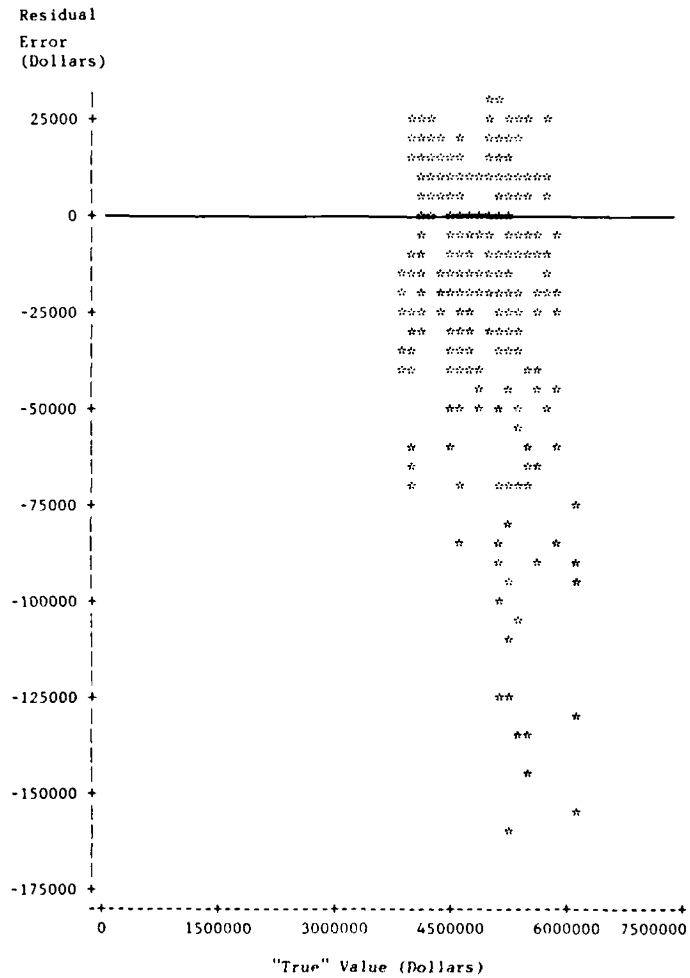


Fig. 9m -- Residual error vs "true" required buy of 0-1 year lead time items for the F004 aircraft alternative peacetime programs

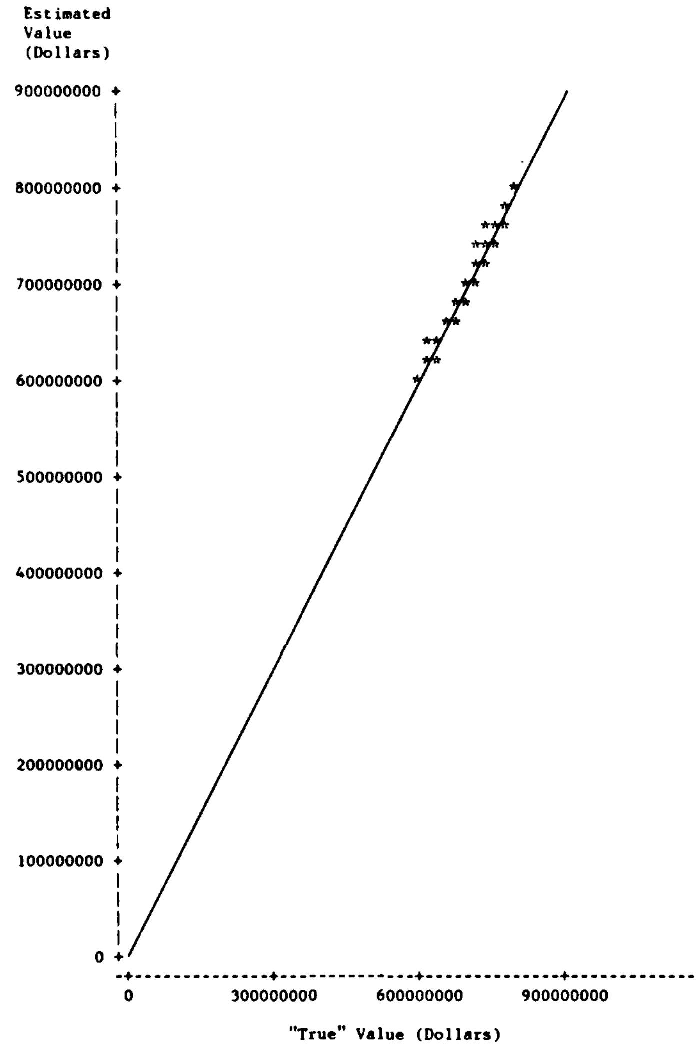


Fig. 9n -- Estimated vs "true" required buy of 1-2 year lead time items for the F004 aircraft alternative peacetime programs

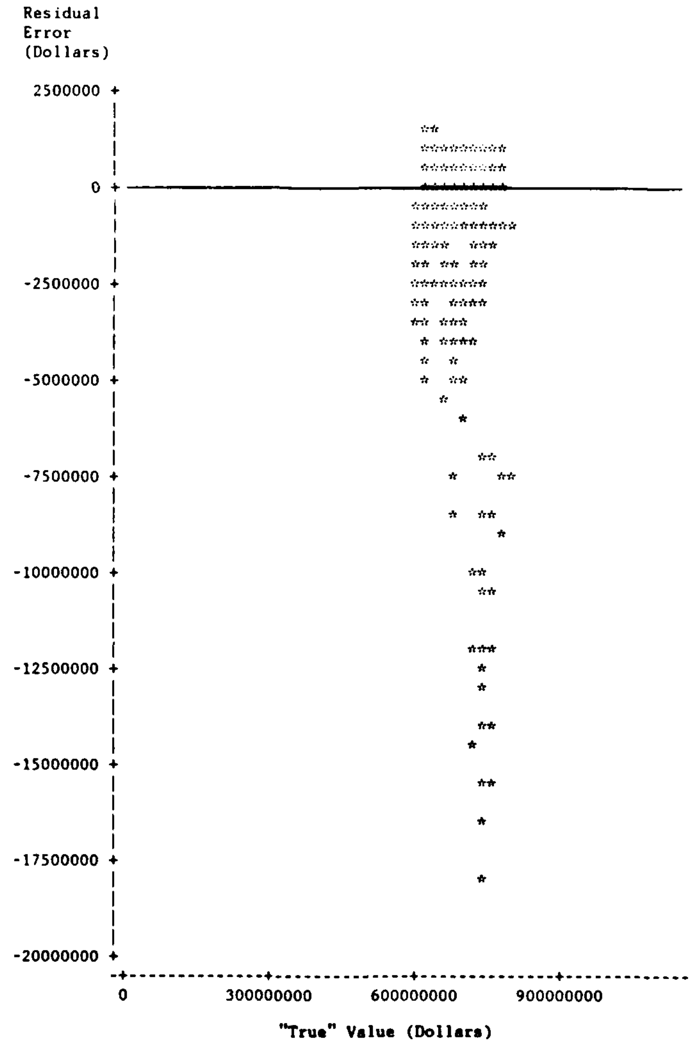


Fig. 9o -- Residual error vs "true" required buy of 1-2 year lead time items for the F004 aircraft alternative peacetime programs

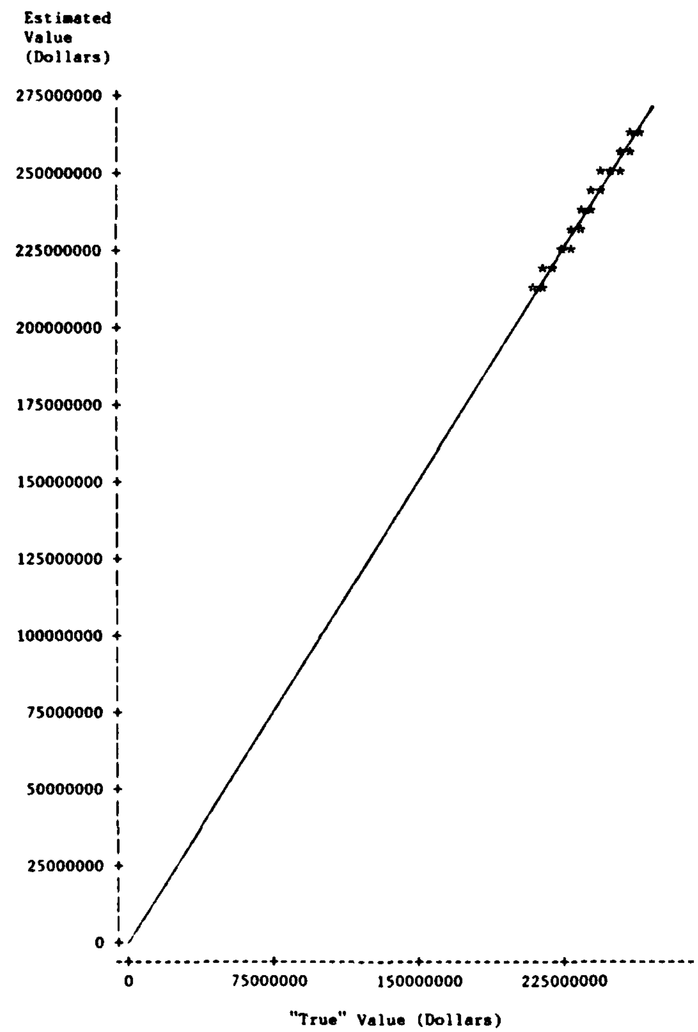


Fig. 9p -- Estimated vs "true" required buy of 2-3 year lead time items for the F004 aircraft alternative peacetime programs

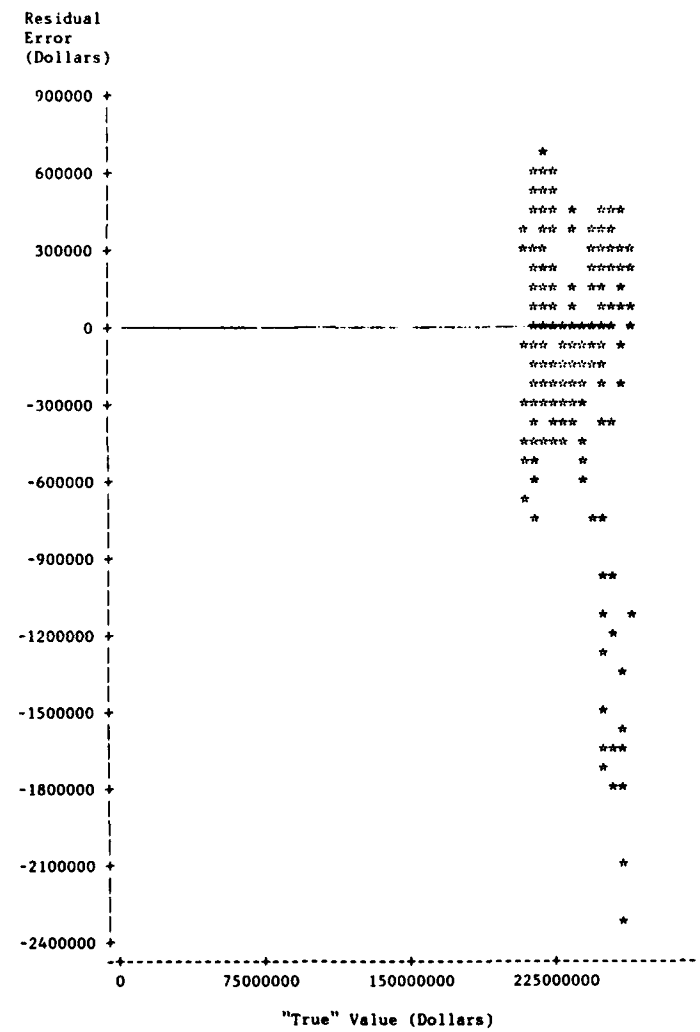


Fig. 9q -- Residual error vs "true" required buy of 2-3 year lead time items for the F004 aircraft alternative peacetime programs

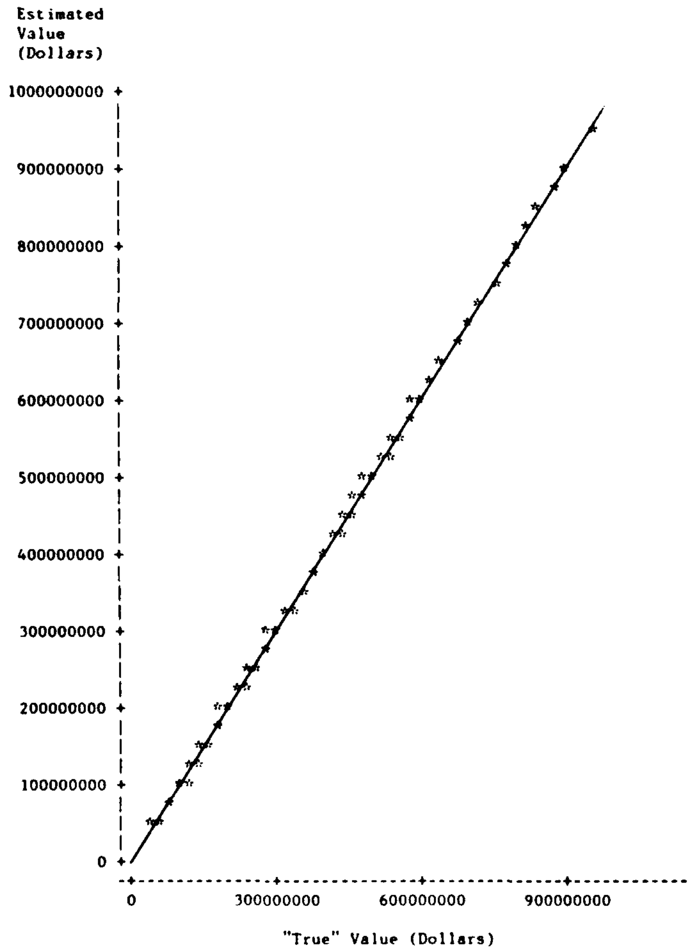


Fig. 9r -- Estimated vs "true" actual depot repairs (valued at repair cost) for the F004 aircraft alternative peacetime programs

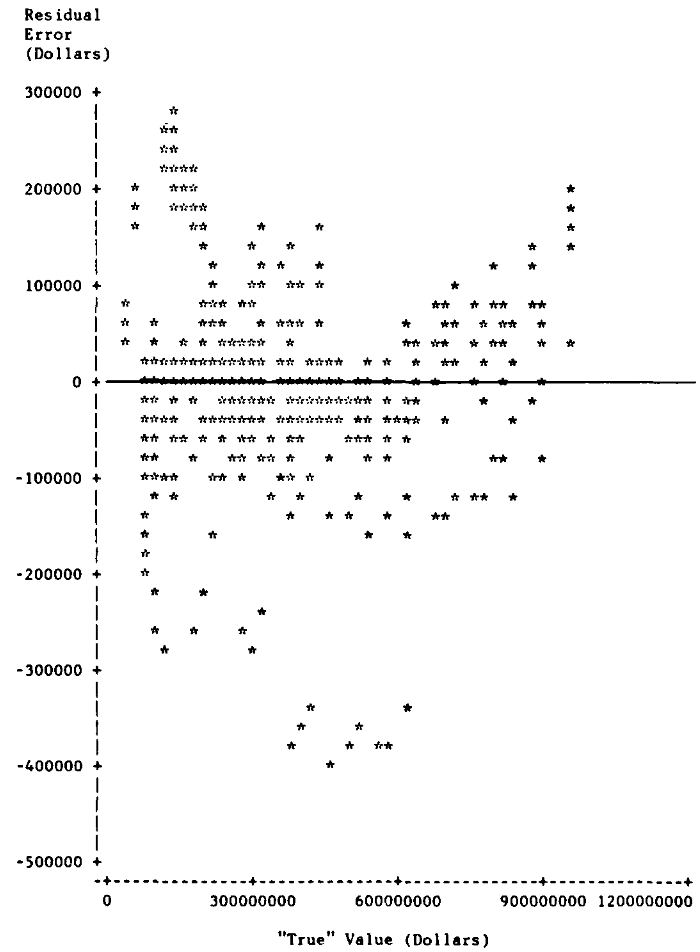


Fig. 9s -- Residual error vs "true" actual depot repairs (valued at repair cost) for the F004 aircraft alternative peacetime programs

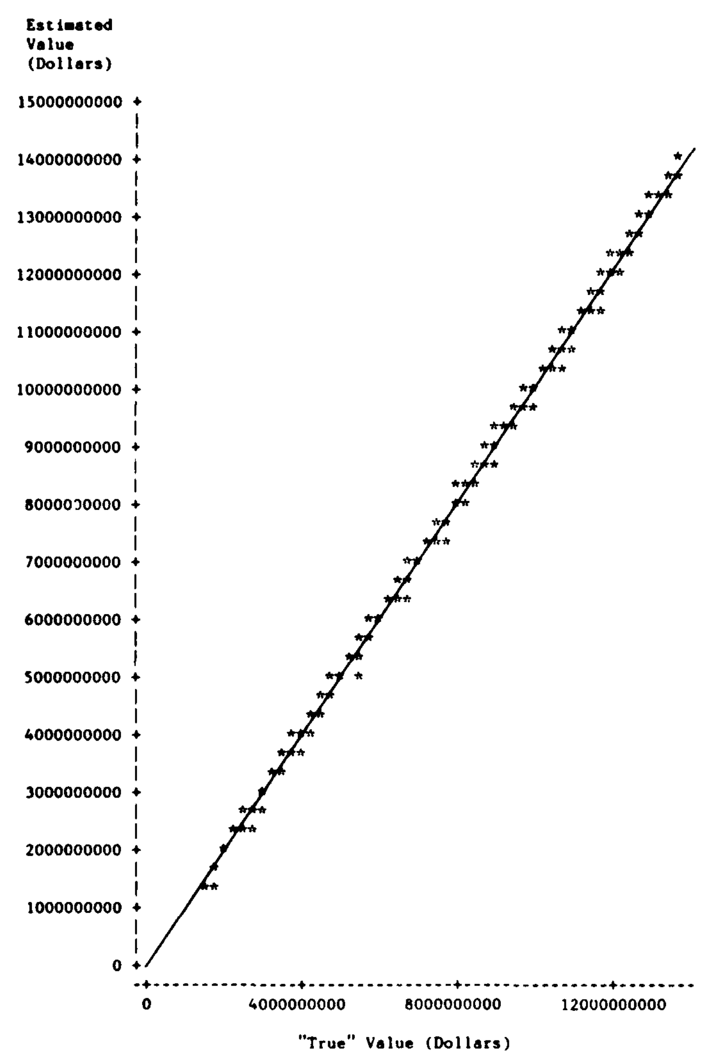


Fig. 9aa -- Estimated vs "true" total gross requirements for the F004 aircraft alternative wartime programs

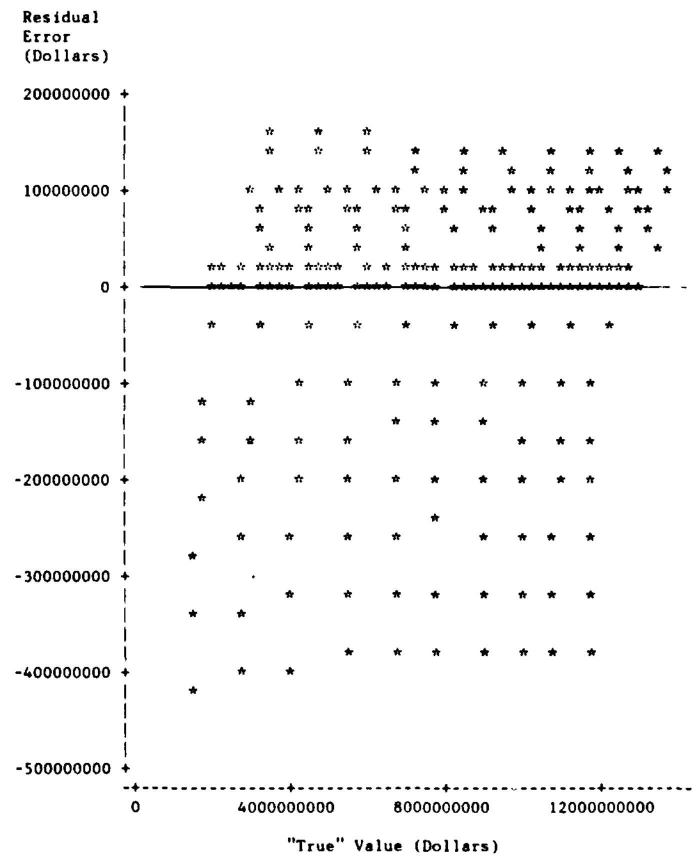


Fig. 9bb -- Residual error vs "true" total gross requirements for the F004 aircraft alternative wartime programs

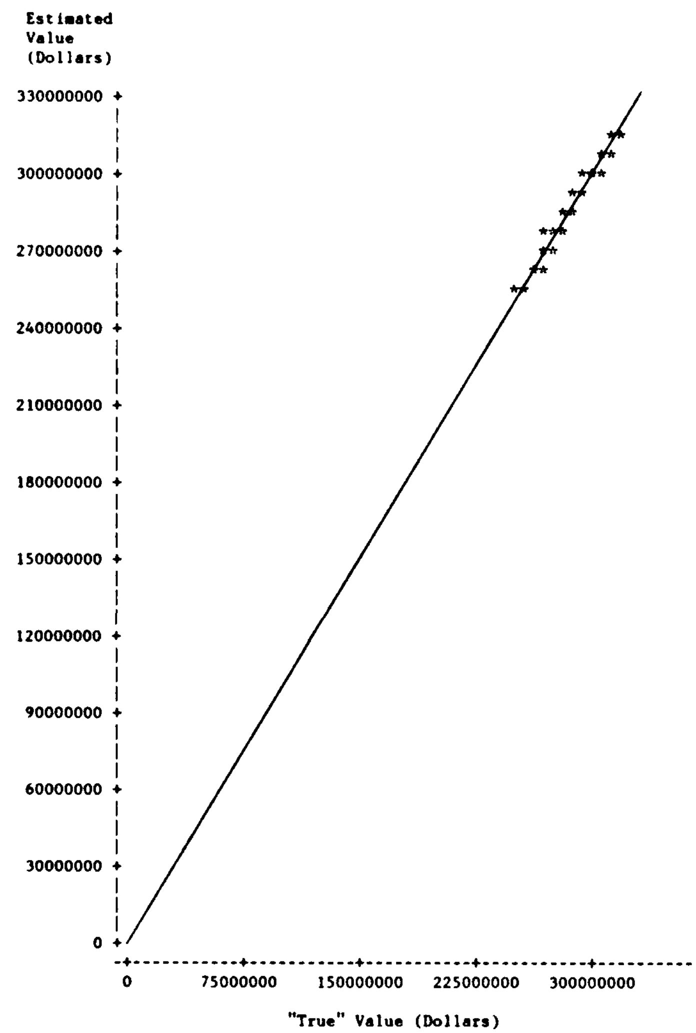


Fig. 9cc -- Estimated vs "true" applied serviceable assets for the F004 aircraft alternative wartime programs

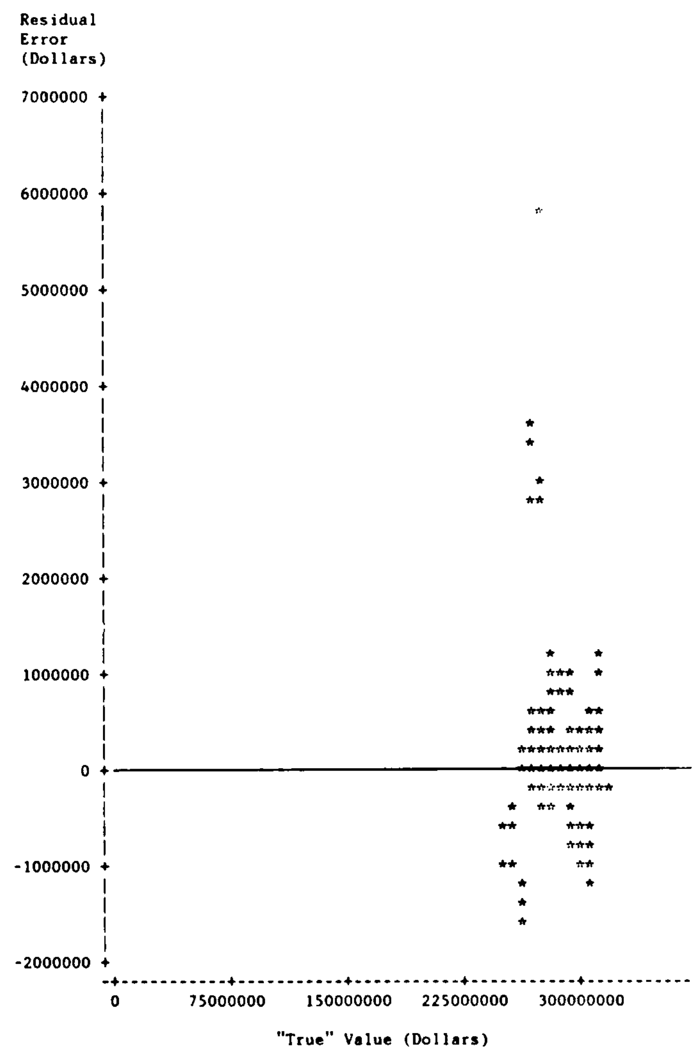


Fig. 9dd -- Residual error vs "true" applied serviceable assets for the F004 aircraft alternative wartime programs

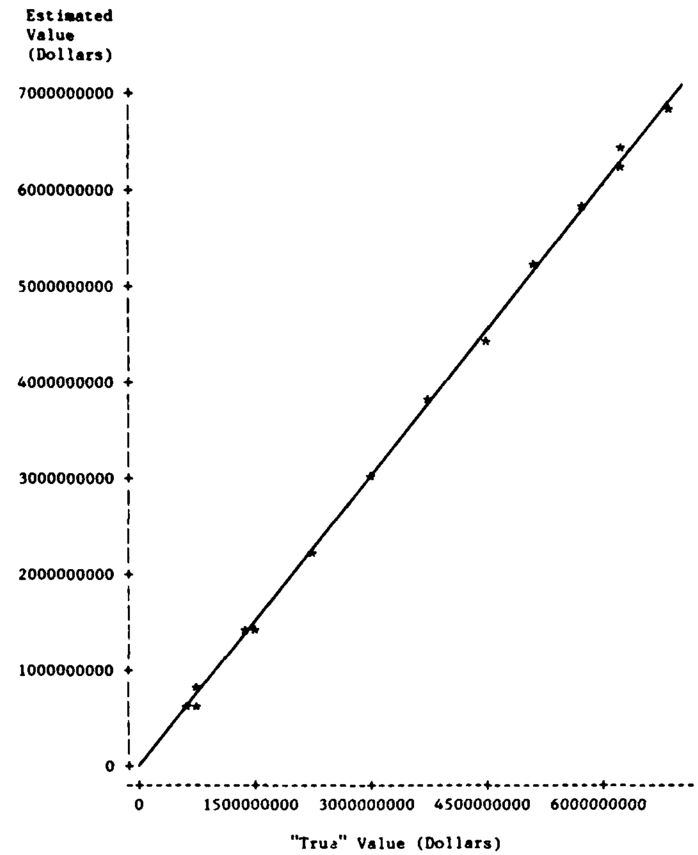


Fig. 9ee -- Estimated vs "true" actual base repairs for the F004 aircraft alternative wartime programs

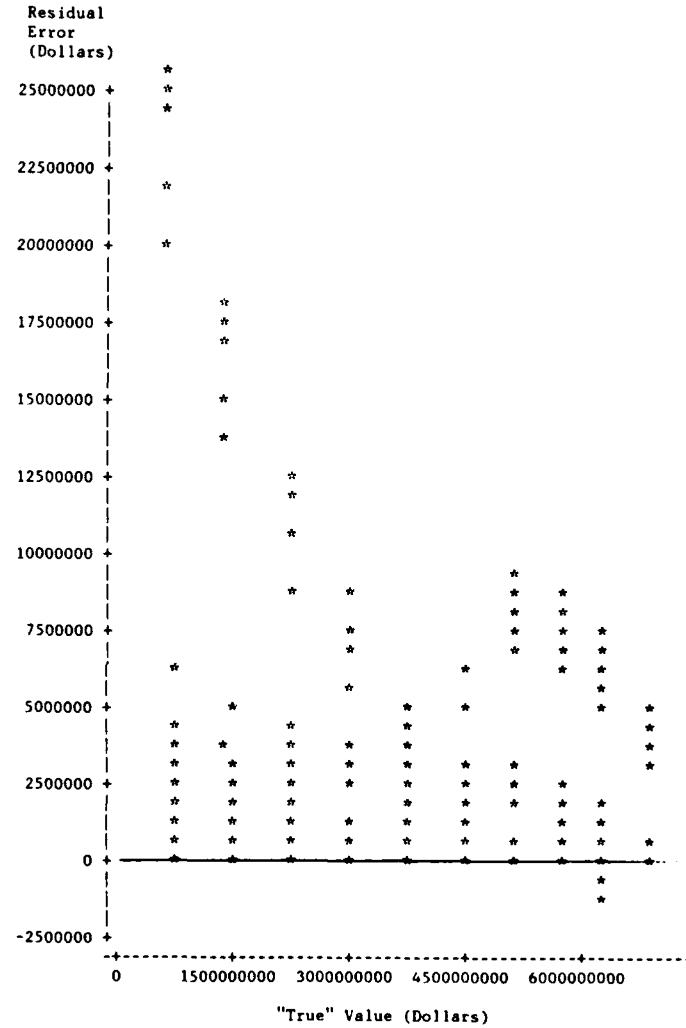


Fig. 9ff -- Residual error vs "true" actual base repairs for the F004 aircraft alternative wartime programs

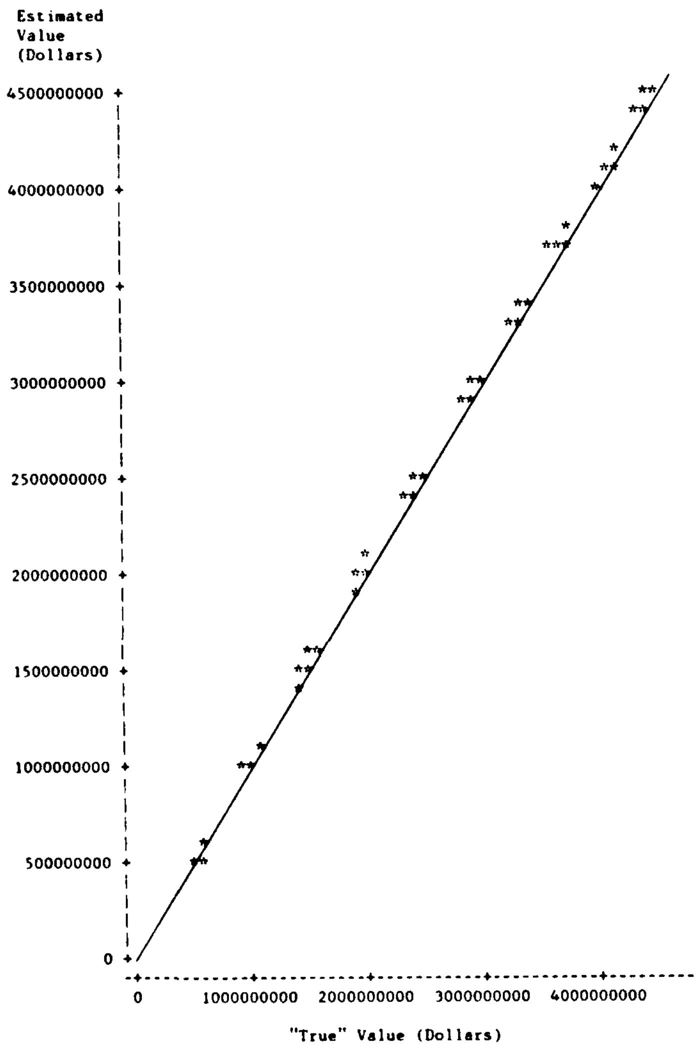


Fig. 9gg -- Estimated vs "true" actual depot repairs (valued at purchase price) for the F004 aircraft alternative wartime programs

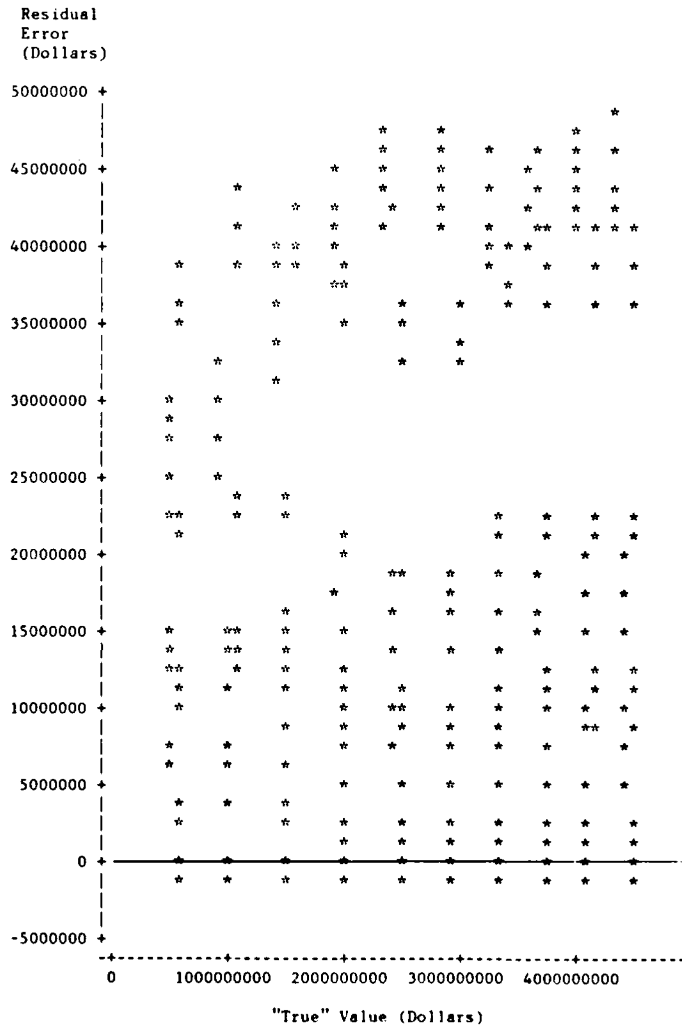


Fig. 9hh -- Residual error vs "true" actual depot repairs (valued at purchase price) for the F004 aircraft alternative wartime programs

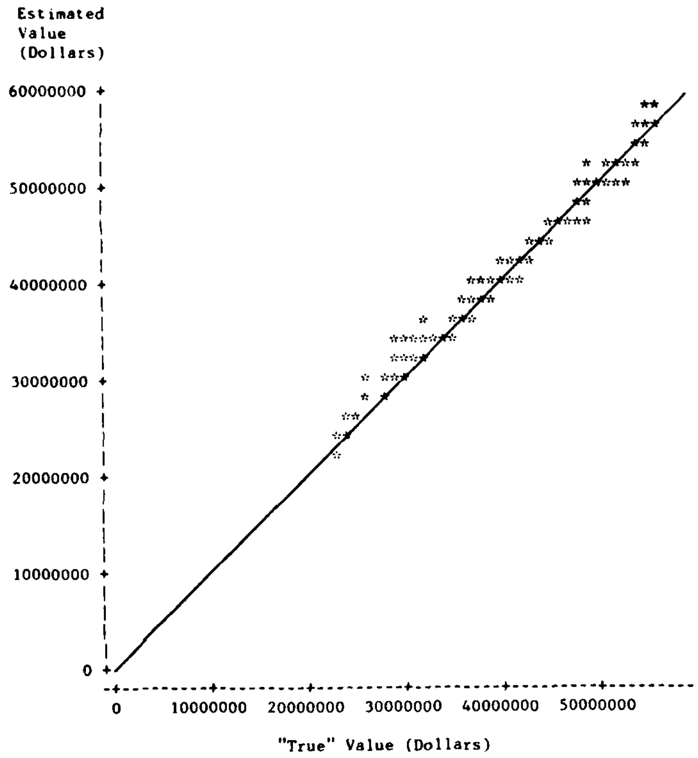


Fig. 9ii -- Estimated vs "true" applied due-in and on order assets for the F004 aircraft alternative wartime programs

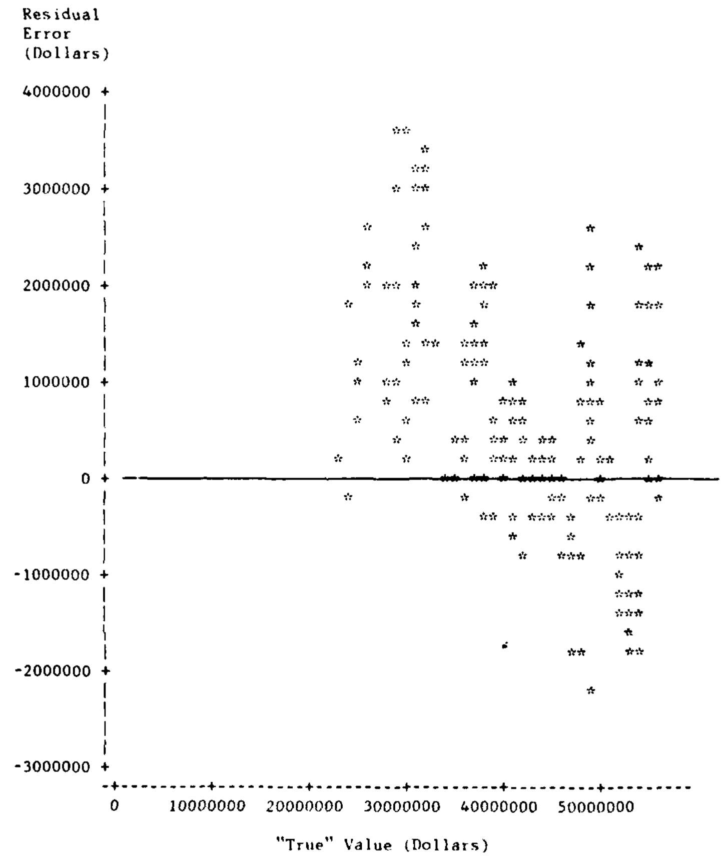


Fig. 9jj -- Residual error vs "true" applied due-in and on order assets for the F004 aircraft alternative wartime programs

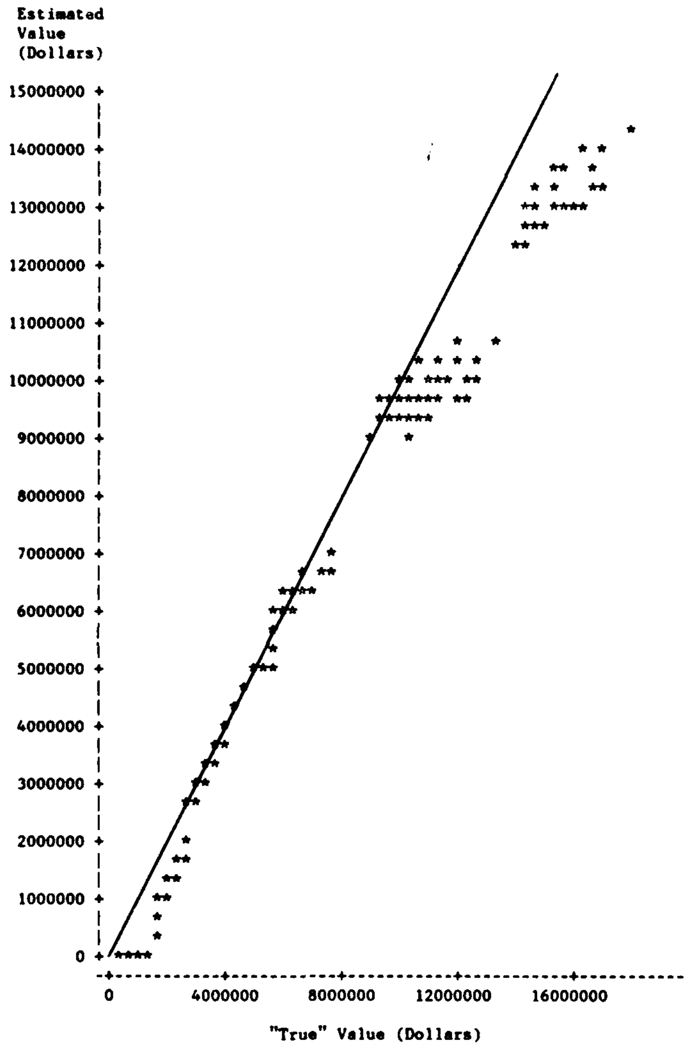


Fig. 9kk -- Estimated vs "true" required buy of 0-1 year lead time items for the F004 aircraft alternative wartime programs

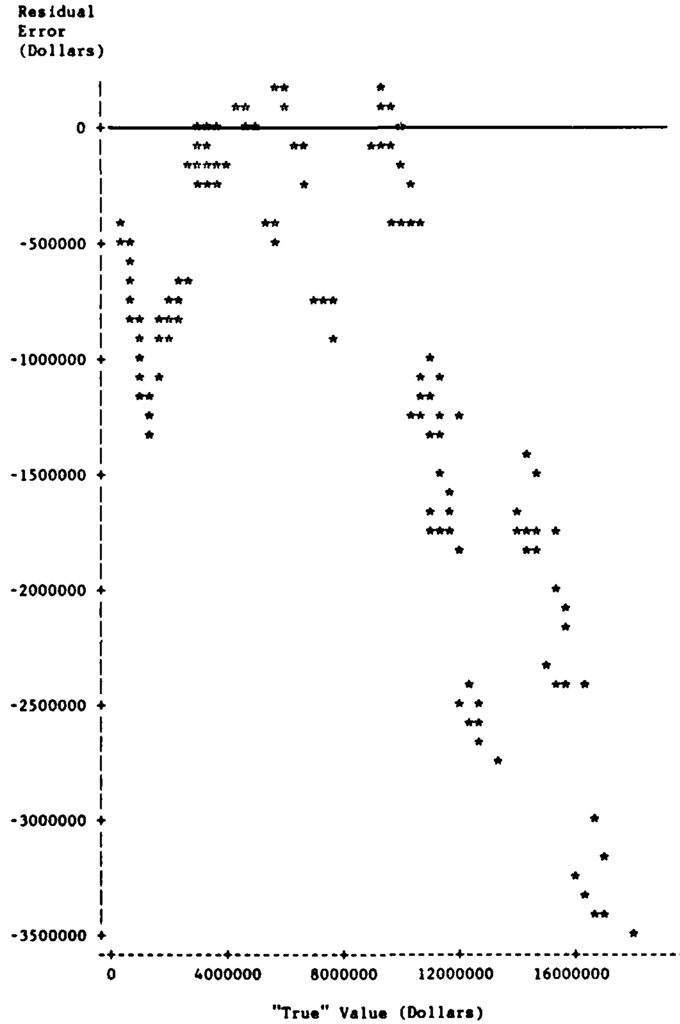


Fig. 9mm -- Residual error vs "true" required buy of 0-1 year lead time items for the F004 aircraft alternative wartime programs

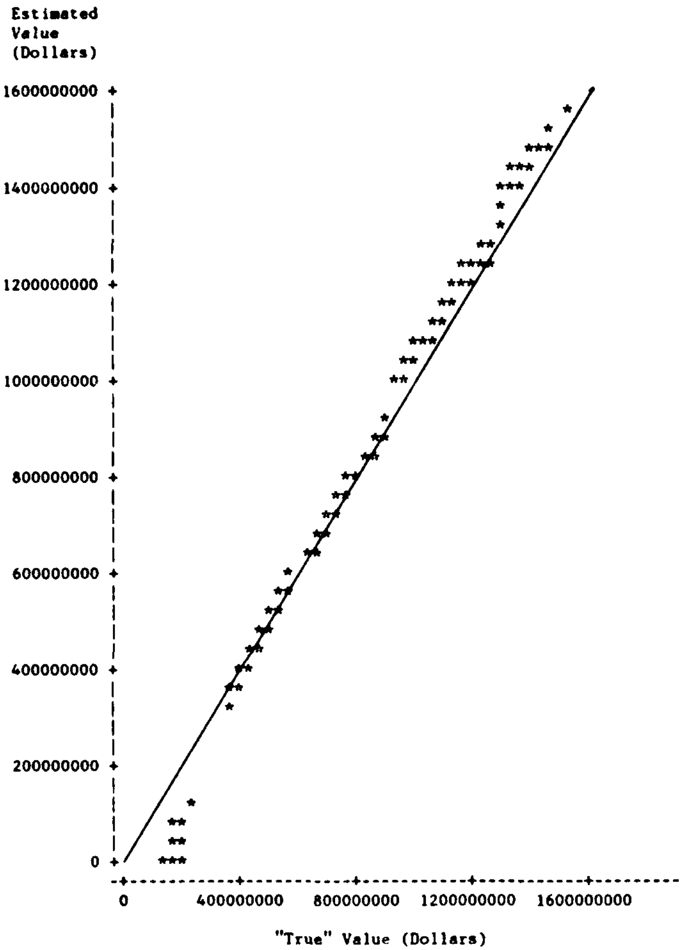


Fig. 9nn -- Estimated vs "true" required buy of 1-2 year lead time items for the F004 aircraft alternative wartime programs

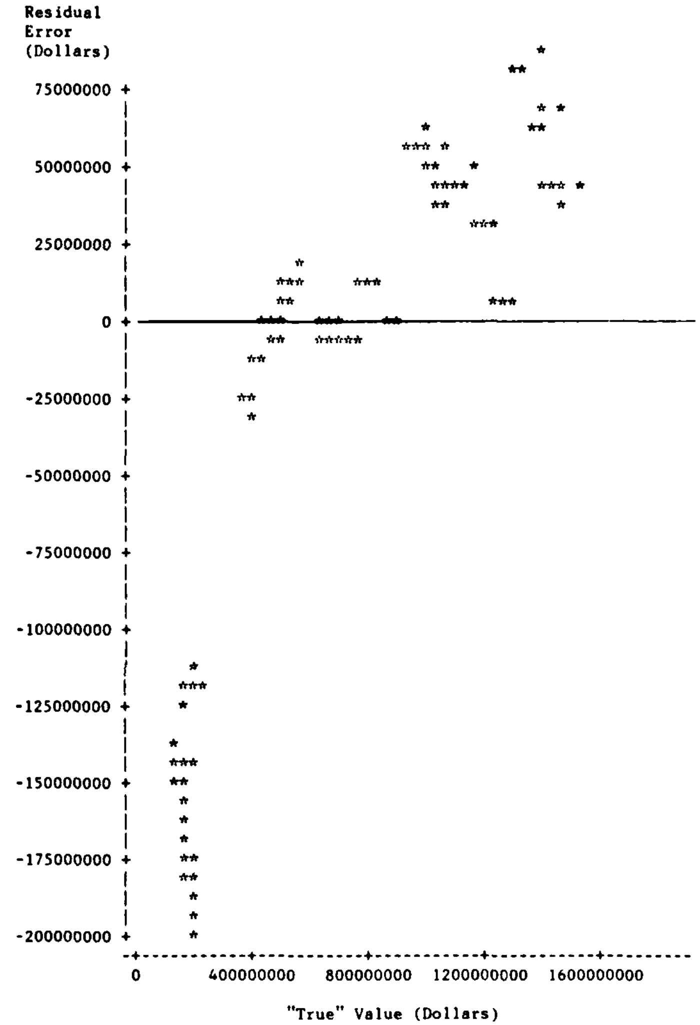


Fig. 9oo -- Residual error vs "true" required buy of 1-2 year lead time items for the F004 aircraft alternative wartime programs

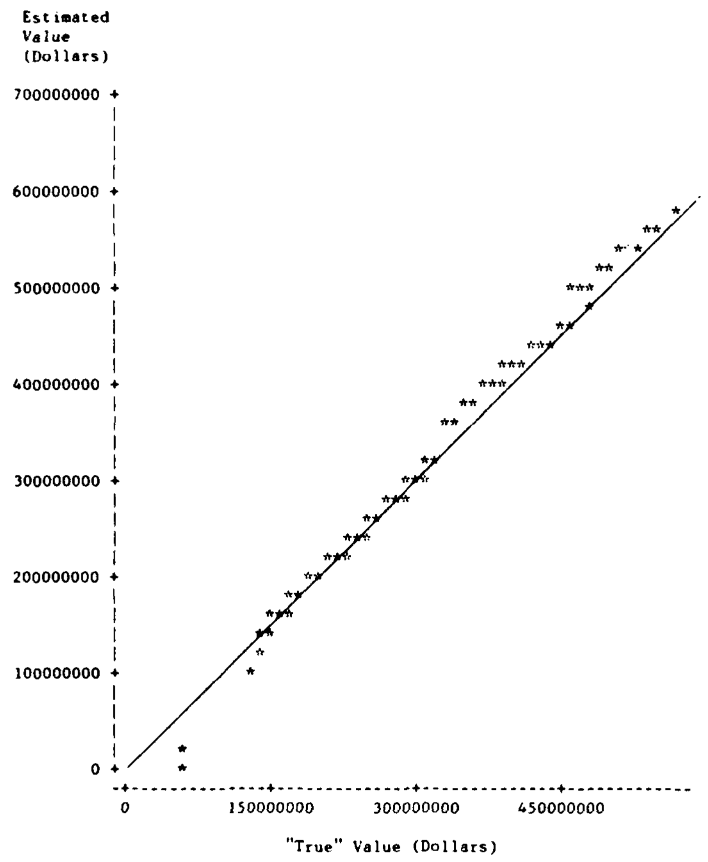


Fig. 9pp -- Estimated vs "true" required buy of 2-3 year lead time items for the F004 aircraft alternative wartime programs

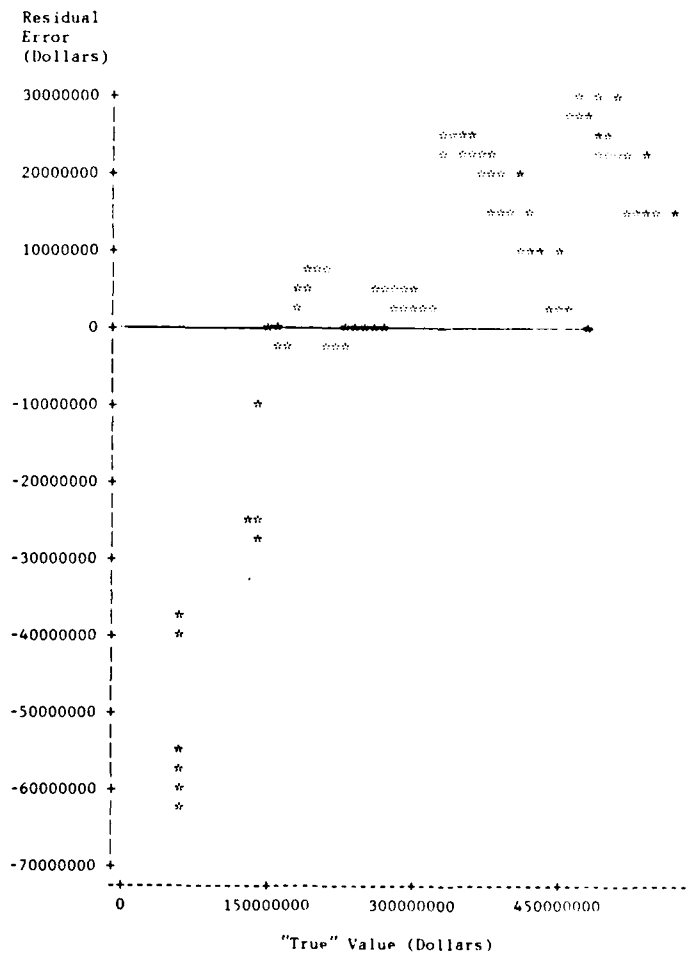


Fig. 9qq -- Residual error vs "true" required buy of 2-3 year lead time items for the F004 aircraft alternative wartime programs

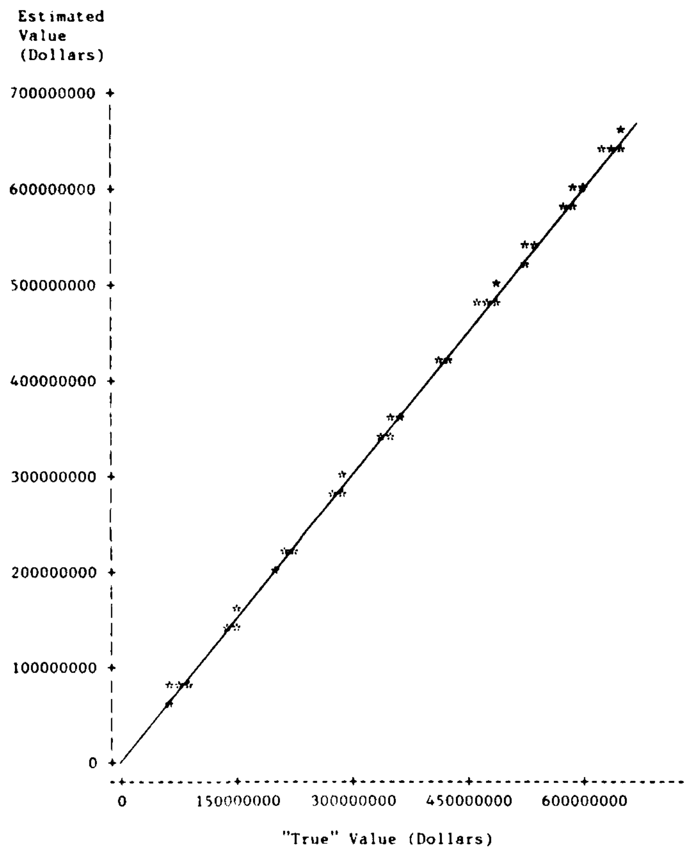


Fig. 9rr -- Estimated vs "true" actual depot repairs (valued at repair cost) for the F004 aircraft alternative wartime programs

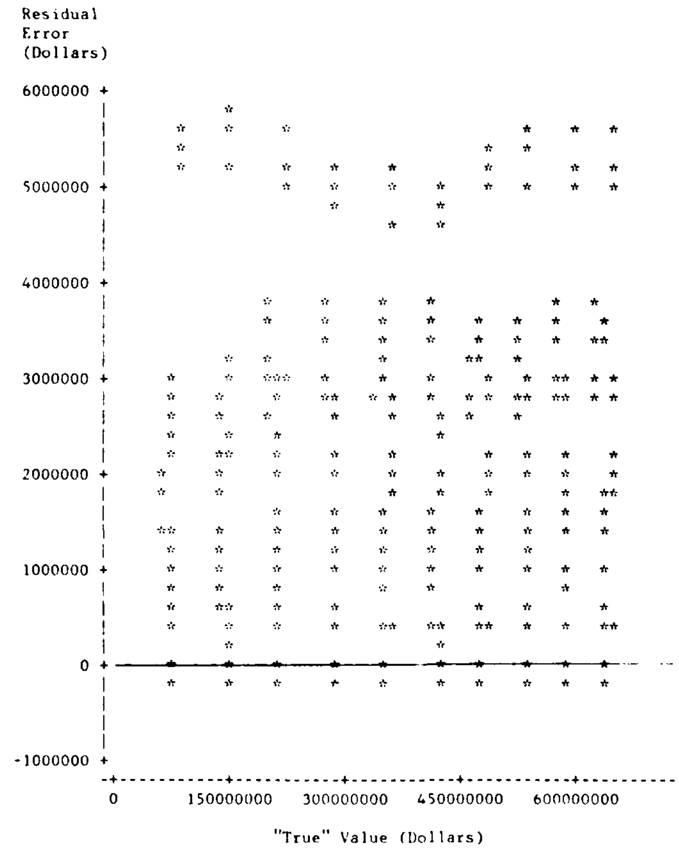


Fig. **9ss -- Residual** error vs "true" actual depot repairs (valued at repair cost) for the F004 aircraft alternative wartime programs

item-by-item computation (horizontal axis), both measured in dollars. If agreement were perfect, all points would lie on a 45-degree line through the origin. The second figure shows the difference between the estimate made using the derivatives and the item-by-item computation (vertical axis) compared to the item-by-item result (horizontal axis). Here, if agreement were perfect, all points would lie on a horizontal line through zero.

The peacetime and wartime cases have separate figures. Each peacetime figure contains up to 450 points, one for each year of each of the 45 peacetime programs. By similar reasoning, each wartime figure contains up to 270 points. Many figures appear to contain fewer than the above numbers of points. In these cases, some points lie on top of others.

Results for the F100 peacetime cases are shown in Figs. 8a-s. For total gross requirements (Figs. 8a-b), there is a good match between the item-by-item computation and the ORACLE approximation using the derivatives. The largest errors are approximately $700,000, with the derivatives overestimating the "true" value (we refer to the value obtained by the item-by-item computation as the "true" value). This error is very small in both relative and absolute terms.

Figures 8c-d show the results for applied serviceable components. The derivative approximation occasionally overestimates the "true" value by nearly $2,500,000, or about 5 percent. The biggest errors occur in tenth-year estimates of cases where the engine overhaul program is only half of nominal. Tables 24e-f show that the derivatives of applied serviceable assets with respect to the accumulated and deaccumulated EOH program drop sharply in the tenth year. This probably reflects the fact that in the nominal case, the serviceable stocks of certain F100 components are exhausted in the tenth year. In all prior years, changes in the program will cause changes in the number of these serviceable components that can be applied against the requirement, but in the tenth year this is no longer true. But when the EOH program is reduced, not only in the tenth year but throughout all ten years of the program, perhaps the item-by-item computation no longer runs out of these serviceable components.

The F100 peacetime results for actual base repairs are shown in Figs. 8e-f. Most errors are very small, but a few overestimates of about $1,250,000 and underestimates of about $1,400,000 stand out. We have identified the outlying points--they come from year 6 of the various cases whose OIM programs are not the nominal. Looking at Table 23d, we note that the derivative of base repairs with respect to the accumulated OIM program is $10 per flying hour in all years except year 6, when it jumps to $13 per flying hour. The derivative is correct, but in this particular case ORACLE's approximation shows significant deviations from the item-by-item results for the large program changes we are considering. We will discuss this derivative more fully in connection with the results for base repairs in the F100 wartime cases.

The value of items repaired at the depot is also well approximated by ORACLE. The maximum error is approximately $1,500,000, and few individual errors are over $600,000. Taken as a percentage of the item-by-item result, the error is trivial, considerably under 1/2 percent in all cases.

ORACLE does not provide an extremely good estimate of the value of due in and on order assets applied (Figs. 8i-j). The maximum error is slightly less than $10 million, and many points have errors of $3 million or more. The largest errors occur in years 7 and 8, and sometimes 9, in the cases in which the OIM program is one-half nominal. Looking at the derivatives of due in and on order assets applied with respect to the OIM program (Tables 23c-23d), we see that they drop sharply after year 6. As we explained for the applied serviceable assets, this probably reflects the fact that after year 6 of the nominal program, this category of assets is exhausted for some components, and these components then cease to contribute to the derivatives of applied due in assets. In cases where the OIM program is low throughout the ten years we consider, these assets are exhausted later and hence are available for application in years 7 and beyond. The item-by-item computation takes advantage of these assets, but the ORACLE approximation cannot, since the derivatives reflect a situation in which the assets are not available. However, the errors are not large in comparison with the hundreds of millions involved with the F100 engine,

and in any case, the value of due in assets applied is not of great import, as it does not have an impact on the budget.

ORACLE estimates that there will never be a buy of items with less than a one year procurement lead time (Figs. 8k-m). For the nominal program (Tables 11) no such items are ever bought, and the derivatives of this quantity with respect to all programs (Tables 23) are all zero. But the item-by-item computation shows that, in a few of the cases with 1.5 nominal OIM or EOH programs, a small amount is required to buy these items. The maximum error is approximately $9,000.

ORACLE estimates the buy of items with lead times between one and two years quite well (Figs. 8n-o). There is a tendency to underestimate more than to overestimate, but the maximum error is less than $240,000, or about 1 percent of the "true" value.

There are bigger errors in the estimate of the buy of items with lead times greater than two years (Figs. 8p-q). The largest errors, all underestimates, are associated with year 6 for cases in which the OIM or the EOH program are higher than nominal, or with years 7 and beyond of cases in which these programs are lower than nominal. Looking at Tables 23d and 23f, we find that the derivatives of this quantity with respect to the OIM and EOH accumulated programs rise dramatically after year 6. Probably, in the nominal case, there are several components with lead times between two and three years whose stocks of serviceable, repairable, and due in assets are finally exhausted during year 7, so any program increases must be accommodated by purchases of the components. Increased programs in earlier years will advance the time at which this should occur, and decreased programs in earlier years should delay it. However, even the largest errors are under $10 million, which is perhaps small enough that ORACLE's estimate is useful.

Finally, ORACLE makes very good estimates of the cost of repairing items at the depot (Figs. 8r-s). A few points are overestimated by $1 million, or underestimated by $750,000, but the bulk of the points have errors of $400,000 or less. Only a handful of points have errors exceeding 1 percent of the item-by-item result, and none has an error as large as 2 percent.

The F100 wartime cases are shown in Figs. 8aa-ss. Figures 8aa-bb show the results for total gross requirements. Here there are considerable errors, ranging from a maximum overestimate of about $50 million, to a maximum underestimate of about $80 million. These are, respectively, about 4 and 7 percent of the "true" requirement, so in relative terms the errors are not enormous. The largest errors occur when the sortie length, L(k), the sorties per day, S(k), and attrition losses per sortie, a(k), are simultaneously varied. We note that the derivatives with respect to peacetime flying hours provide very good estimates, and we speculate that derivatives with respect to wartime flying hours would do as well. But the relation between L(k), S(k), and a(k) on the one hand, and the wartime flying hours on the other hand, is such that the derivatives provide a poor approximation.

For example, if we neglect attrition, the total wartime flying hours in a given period is proportional to the product of the sorties per aircraft per day and the sortie length. If both of these parameters are doubled, flying hours will quadruple. But in using derivatives we would add the change resulting from doubling sorties per day (for constant sortie length) to the change resulting from doubling the sortie length (for constant sorties per day). By this rule, one would estimate that wartime flying would rise by only a factor of three, instead of a factor of four.

Thus, the wartime comparisons might be greatly improved by calculating derivatives with respect to wartime flying hours instead of to attrition, sortie length, and sorties per aircraft per day. Because the wartime flying program is not steady, it would be necessary to divide the wartime scenario into several segments, and to consider flying hours in each. One might consider, for example, flying in the first five days, the next five, the next ten, and whatever period remained after day 20 until support first became available from the depot. Given these derivatives, one could still estimate the effect of changing attrition, sortie length, or sorties per day per aircraft, by first calculating how the changes in these latter quantities affected flying hours in each of the designated periods, and then applying the derivatives to the flying hour changes.

Figures 8cc-dd show the results for the applied serviceable assets. The largest error is just $600,000, or 1.3 percent of the "true" value.

Figures 8ee-ff show the results for actual base repairs. One may ask how a change in a wartime scenario, which influences only PWRM requirements (in our prototype; recall we have not related OWRM requirements to the scenario), can affect actual base repairs. What must happen is this: there must be one or more components that can be repaired at base level and which have PWRM requirements. Under the nominal programs, it is necessary that in one or more years, some of these components are repaired at base level, but not all that could potentially be repaired. If none were repaired, then the entire requirement for these components would have been satisfied out of on-hand serviceable assets, and any change in the wartime scenario would simply cause more or fewer serviceable assets to be applied (until they ran out). If as many of these components as possible were repaired at base level, a change in the wartime scenario would not affect the number repaired because it could not affect the number available for repair. Only if some but not all of the possible repairs were done under the nominal program would a change in the wartime scenario affect actual base repairs.

Looking at Tables 23g-23u, the tables of wartime derivatives for the F100, one finds that only in year 6 are the derivatives of actual base repairs not zero. Indeed, the few large errors that appear in Fig. 8ff all occur in year 6 of one wartime case or another. This is the same year that gave the largest errors in the peacetime cases, and there, too, the year 6 derivative stood out. The explanation is made the same, except that in the peacetime cases, a OIM program change will affect the potential base repairs, so the derivatives in years other than year 6 need not be zero.

Figures 8gg-hh show the results for actual depot repairs. A change in the wartime scenario can affect actual depot repairs, but not potential depot repairs, for the same reasons as given in the case of actual base repairs. The largest overestimate is about $1.6 million, or 0.3 percent of the "true" value.

Results for due in and on order assets appear in Figs. 8ii-jj. The maximum error is $2 million, or 5 percent of the "true" value.

In all F100 wartime cases, there was a requirement of zero for buying components with less than a one year lead time. We therefore do not include figures for this quantity.

Figures 8nn-oo show results for the buy requirement for components with lead times between one and two years. When the "true" requirement is low, the ORACLE methodology tends to underestimate badly. The reason is that the item-by-item computation will never buy less than zero of any component. But the derivatives can continue to estimate that the buy of every component will be reduced, even after none of a component is being bought.

The worst overestimates occur in those cases where the sortie length, sorties per day per aircraft, and attrition rates are varied simultaneously. We discussed this phenomenon earlier and suggested that using derivatives with respect to wartime flying hours might yield better results. Still, the errors in ORACLE's estimates of the buy requirement for these components is only $6 million. This sum is not large compared with numbers routinely dealt with in the PPB process.

The results for the buy requirement for components with lead times between two and three years are shown in Figs. 8pp-qq. They are much the same as the results for one to two year lead time components; the errors are larger in absolute magnitude, but they constitute a similar percentage of the "true" value. The errors here reach $50 million dollars. It could be important to improve this match; the improvement could probably be obtained by reformulating the wartime scenario as suggested above, to deal directly in wartime flying hours instead of sortie lengths, sorties per day per aircraft, and attrition losses per sortie.

Figures 8rr-ss give the results for the cost of actual depot repairs. There is a very small maximum error ($700,000), which looks even smaller viewed relative to the "true" value (0.6 percent).

Now we turn to the F-4 peacetime results, which are shown in Figs. 9a-s. The total gross requirement (Figs. 9a-b) show as a maximum error an underestimate of about $20 million. Some additional cases with

underestimates of about \$5 million also stand out, but the bulk of the cases have errors below \$3 million. In relative terms, the worst error is only 0.2 percent of the "true" value.

The cases with errors in the \$5 million range have high target aircraft availabilities and a nominal OIM program. This reflects the fact that requirements to support successive increments of availability become progressively more costly. The cases with errors in the \$20 million range all have higher than nominal target aircraft availabilities (nominal is 83 percent, high is 92 percent), coupled with a higher than nominal OIM program (1.5 nominal). There may be some interaction between these parameters that has a similar effect to the interaction noted earlier between certain wartime scenario parameters.

The errors in the estimates for applied serviceable assets (Figs. 9c-d), actual base repairs (Figs. 9e-f), and actual depot repairs (Figs. 9g-h) are all small, both in absolute terms and as percentages of the "true" values. The errors in the applied due in estimate (Figs. 9i-j) are also rather small in absolute terms, even though they are as much as 10 percent of the "true" values.

The requirement for buying components with a lead time less than one year (Figs. 9k-m) is estimated very closely, with a maximum error of about \$170,000 out of a total requirement of \$6 million. The buy of one to two year lead time components (Figs. 9n-o) also shows a small error in relative terms but, because of the larger requirement, the maximum absolute error is about \$18 million. The results for the buy of two to three year lead time components (Figs. 9p-q) are intermediate between these two, with a maximum error of \$2.4 million. The cases for which the largest buy errors occur are the same as the cases for which the largest errors occurred in estimating total gross requirements, namely, cases with a high target aircraft availability or cases with both a high availability and a high OIM program.

Figures 9r-s show the results for the cost of actual depot repairs. The maximum error here is only \$400,000, or 0.1 percent of the "true" value.

The F-4 wartime results are presented in Figs. 9aa-ss. For total gross requirements (Figs. 9aa-bb), the biggest overestimates are about $160 million, and the biggest underestimates are just over $400 million. The large overestimates occur when the sortie length, L(k), and the attrition rate, a(k), are simultaneously raised above their nominal values. The large underestimates occur when the sortie length and sorties per day per aircraft are both lowered. We discussed earlier why this might occur and how it might be circumvented.

The results for applied serviceable components (Figs. 9cc-dd) show small errors, both in absolute terms and relative to the "true" values.

The results for actual base repairs (Figs. 9ee-ff) and actual depot repairs (Figs. gg-hh) show small errors relative to the "true" values but errors that are large enough in absolute terms to merit notice. The results for applied due in assets (Figs. ii-jj) have smaller absolute errors, but they are larger relative to the "true" values. Again, the large errors occur in those cases in which sortie length, sorties per day per aircraft, and attrition are simultaneously varied.

The results for buys of components with less than one year lead times (Figs. 9kk-mm), between one and two years (Figs. nn-oo), and between two and three (Figs. pp-qq) years are all similar to each other and to the results for buys of F100 engine components. When the "true" buy is low, the ORACLE estimate is likely to be lower. This is because the "true" buy never includes a negative buy of any component, whereas when ORACLE uses the derivatives, it cannot tell when the buy of an individual component is about to become negative. When the "true" buy is not low, the largest errors are again associated with cases in which sortie length, sorties per day per aircraft, and attrition losses per sortie are varied simultaneously.

Finally, the results for the cost of actual depot repairs are shown in Figs. 9rr-ss. These are much the same as the results for actual depot repairs valued at the purchase prices of the components.

Each potential user of the ORACLE methodology must evaluate whether the validation shows the methodology to be "good enough" for his application. However, we do offer the following general thoughts.

In the PPB process, it is unlikely that program changes as large as those we have used would be considered. For smaller program changes the results should be much better. Indeed, theory suggests that the error may grow in proportion to the square of the program change; if so, halving the change will cut the error by a factor of four.

The errors for peacetime cases are generally small in comparison to the "true" values. But the "true" values are themselves estimates of what will have to be bought or repaired at some future time. History suggests that errors of 5 or 10 percent in these estimates are not unusual. So it is not clear that the ORACLE estimates are "worse" than the "true" values, in most cases, even when the two are different.

For the wartime cases, the relative errors are large for cases in which sortie lengths, sorties per day per aircraft, and attrition rates are varied simultaneously. We have suggested a change in formulation that might reduce these errors markedly. In any case, if only one of these parameters at a time is changed, or if the changes considered are small, the errors are likely to be tolerable.

Finally, there are occasional derivatives that are valid only over a very small range of program quantities. We discovered examples in the F100 peacetime cases in the derivatives of actual base repairs in year 6. It may be possible to recognize instances of such derivatives by looking for abrupt changes in the derivatives from one year to the next. But we have no suggestions concerning what may be done to improve the ORACLE estimates once the situation is discovered.

5.5. SOME SAMPLE APPLICATIONS

5.5.1. Example 1

In this subsection we present some examples of the kinds of questions that the ORACLE database can help answer. First consider shifting flying hours from the C-141 to the F-16. We ask, in what ratio can the flying hours be shifted to hold the depot repair budget constant? And, if this shift is made far enough in the future so that buy decisions have not yet been made (say in year 4 after asset cutoff), what will be the impact of this shift in flying hours on the requirements to buy spares in the preceding years?

To answer these questions, we look to Tables 31c-31d for the C-141 derivatives and Tables 34c-34d for the F-16 derivatives. We must also consider their engines, the F100 (Tables 23c-23d) and the TF033 (Tables 26c-26d). Table 4 shows that the C-141 uses four TF033 engines and the F-16 uses a single F100 engine. For every flying hour shifted away from the C-141 in year 4, a savings in depot repair costs of $8 will accrue in year 4 because of the change in the deaccumulated OIM program, and a savings of $80 will accrue, again in year 4--and similar amounts in all later years--because of the change in the accumulated OIM program. When one flying hour is taken from the C-141, four hours must be taken from the TF033 engine. By the same method as used for the C-141, this saves $60 in year 4 and $56 in all years thereafter. Differencing successive years, we see that the necessary expenditure on depot repairs of C-141 aircraft and TF033 engine components drops in year 4 by $148 and rises in year 5 by $14. There is no change in any other year. For the F-16 plus its engine, the similar calculation shows an increase in year 4 depot repair costs of $1250 per F-16 flying hour, a decrease in year 5 of $1, and no change in the other years.

If we ignore year 5 and seek only to keep the year 4 depot repair budget constant, then we must reduce C-141 flying by 8.45 hours for every hour by which we increase F-16 flying. This is the ratio of $1250 to $148.

It is easy to estimate that the effect of this on year 5 depot repair expenditures is an increase of $117.30 for every hour increase in F-16 flying and commensurate decrease in C-141 flying. If we wished to keep year 4 plus year 5 depot expenditures constant, we would have decreased C-141 flying by 9.32 hours for each hour increase in F-16 flying. This would have resulted in a decrease in year 4 depot repair costs of $129.49 and an equal increase in year 5 costs.

To determine what effect a decrease of 8.45 C-141 flying hours and a simultaneous increase of one F-16 flying hour has on the buy requirements, we again look to Tables 24c-d, 27c-d, 32c-d, and 35c-d. Concentrating only on the requirements in year 4, the results are:

- a decrease of \$29.23 in the buy requirement for zero to one year lead time items;
- a decrease of \$422.15 in the buy requirement for one to two year lead time items;
- and an increase of \$62.49 in the buy requirement for two to three year lead time items.

Thus, there is a net decrease in the total buy requirement, but the earliest impact, which must be the impact on items with the longest lead times, is a modest increase.

5.5.2. Example 2

From Table 20c, we see there are requirements for long lead time F-15 components to be delivered in years 1 and 2. But to be received by this time, they would have to have been ordered one or two years before asset cutoff, which was not done (or they would have been due in or on order assets). Evidently, the programs for the F-15 must be scaled back to eliminate these "impossible" requirements. We ask, what changes in the flying hour program of the F-15 are needed to accomplish this?

Clearly, cuts in flying hours later than year 2 will have no effect on buy requirements before asset cutoff, since the longest lead times are three or less years. Thus, we let D1 be the decrease in year 1 hours and D2 be the decrease in year 2 hours. These are the cuts in the deaccumulated program; the accumulated program suffers cuts of D1 in year 1 and D1 + D2 in every year thereafter.

To determine what impact these cuts in flying hours will have on the impossible buy requirements, we look to Tables 33c-33d. In particular, we need the derivatives of the one to two year and two to three year buys with respect to both the accumulated and deaccumulated programs. We can write:

$$360 * D1 + 10 * D1 = \text{Reduction in required deliveries of two to three year lead time items by end of year 1}$$

$$\geq \$73,543,000$$

The figure of $17 million dollars is from Table 20c; it is the size of one of the "impossible" requirements. The other two impossible requirements also impose conditions, as follows:

$$357 * D1 + 10 * (D1 + D2) = \text{Reduction in required deliveries of two to three year lead time items by end of year 2}$$

$$\geq \$80,629,000$$

$$126 * D1 + 12 * D1 = \text{Reduction in required deliveries of one to two year lead time items by end of year 1}$$

$$\geq \$46,471,000$$

From these expressions we can deduce that D1 must be at least 337,000 hours (there is no need for D2 to be other than zero). But looking at the F-15 peacetime program (Table 7f), we find that in the first year, the F-15 is programmed to fly only about 39,000 hours. Clearly, it is not possible to eliminate the "impossible" requirements by cutting the flying program. Indeed, it is easy to show that it cannot be done even by eliminating all peacetime programs.

Let us suppose, therefore, that we continue to support the F-15 peacetime programs as given, and ask what the nondelivery of the "impossible" requirements implies for the ability of the F-15 to go to war. We must reduce the year 1 requirement for one to two year lead time components by about $46.5 million. Table 33i says that if we demand one fewer sortie per day from each possessed aircraft during our wartime scenario, we will save $15.5 million. Thus, to reduce the

requirement by $46.5 million will require a reduction of more than three sorties per day per aircraft, and that is as much as the scenario demands. We cannot trust the derivatives to provide accurate estimates for such huge program changes, but it is evident that we cannot both support the F-15 peacetime program and simultaneously keep the F-15 fleet prepared for much of a war.[2]

The third step, since we would not wish to curtail the wartime scenario so much, would be to look at the additive quantities, including the OWRM requirements. Some of them might well have lower priorities than PWRM. Of course, the programs we have considered in our prototype do not affect these requirements, so an off-line analysis would have to be done to determine the programmatic changes necessary to effect the needed reductions.

5.5.3. Example 3

In our final example, we examine the tradeoff between the sorties per aircraft flown by the F-15 in its wartime scenario and the hours flown by the same aircraft in peacetime. We will consider the third year of the program, since that is the earliest year in which we can procure the long lead time components (two to three years) needed to support the program. We will determine how many peacetime flying hours must be given up in year 3 for each incremental sortie per aircraft per day in wartime, if the year 3 buy requirement for two to three year lead time components is to remain constant.

Tables 33c, 33d, and 33i give derivatives of F-15 component requirements with respect to the deaccumulated and accumulated OIM program and the sorties per day per aircraft, respectively, and Tables 23c, 23d, and 23i show these derivatives for F100 component requirements. The F-15 uses two F100 engines, so to answer our question we will use the F-15 derivatives plus twice the F100 derivatives. The effect of the changing the OIM program in year 3 on the buy requirement of two to three year lead time components is the sum of the derivatives

---

[2] We caution the reader that these examples reflect the component inventories from the 1980 D041 database and the programs from the PA 84-1, which gives flying hours for years starting in 1982. There may actually have been more components in hand by 1982, and the picture may not have looked so grim.

with respect to the deaccumulated and accumulated OIM program; from Tables 33c, 33d, 23c, and 23d we obtain the elements of this sum, which comes to a total of \$610 per flying hour in year 3. The effect of changing the sorties per day per aircraft requires derivatives from Tables 33i and 23i; the total is \$94.95 million per incremental sortie per day. Thus, to enable the F-15 fleet to be prepared to fly and additional 0.1 sortie per day per aircraft (3.1 sorties instead of 3) for the 30 day wartime scenario, peacetime flying must be reduced by (\$94.95 million/\$610) x 0.1 or 15,600 hours per year. Tradeoffs in this ratio will leave the buy requirement for two to three year lead time components unaffected.

The same calculation can be made holding the buy of one to two year lead time or zero to one year lead time components constant, and the resulting tradeoff is approximately the same. To hold the one to two year lead time buy constant, peacetime flying must be curtailed by 13,900 flying hours per year. To hold the zero to one year lead time buy constant, the figure is 13,500 flying hours per year. Both will permit an increase of 0.1 in the wartime sorties per aircraft per day.

One may ask if this tradeoff seems reasonable. In Sec. 4.6.2, the following equation is given for the cumulated wartime flying hours for a squadron of aircraft:

$$CH(k,t) = L(k) * A(k,0) * \frac{1 - \exp(-0.01 * a(k) * S(k) * t)}{0.01 * a(k)}$$

The scenario parameters for the F-15 can be found in Table 10f. The sortie length, L(k), is 2.0 hours, and the initial aircraft per squadron, A(k,0), is 24. The attrition losses per sortie, a(k), are 0.7 percent, and the sorties per day per aircraft number, S(k), is 3.0. We are interested in the entire period that PWRM is intended to support, so we substitute 30 days for t. To find total flying hours for the F-15 fleet, we must multiply by the total number of squadrons, which is 21 in year 3. To determine the effect of the sorties per day per aircraft on total flying hours, we take the derivative with respect to S(k). The result is:

$$\frac{d(21 * CH(k,t))}{dS(k)} = 21 * L(k) * A(k,c) * t * \exp(-\frac{a(k)}{100} * S(k) * t)$$

$$= 21 * 2 * 24 * 30 * \exp(-.01 * .7 * 3 * 30)$$

$$= 16,100 \text{ hours/incremental sortie rate.}$$

Thus an increase in S(k) of 0.1 will increase the first 30 days of wartime flying of the F-15 fleet by 1610 hours. To enable this to happen without increasing the requirement for two to three year lead time components, we had to sacrifice 15,600 hours in a year, which scales to about 1300 hours in each 30 day period. We conclude, then, that if in any period we reduce the F-15 peacetime flying rate by a given amount, then for a period of similar length we will be prepared to increase the wartime flying rate by a similar amount, without affecting our requirements for components.

6. SOME DIRECTIONS FOR FURTHER RESEARCH

There are several directions in which the methodology described here could be extended, and each of these directions calls for research. First, ORACLE could consider more resources. Second, we could extend ORACLE to relate OWRM to parameters describing wartime planning scenarios, particularly long (more than one year) scenarios. Third, and perhaps most important, we could develop ORACLE into a requirements forecasting methodology. In the sections that follow, we will briefly discuss each of these directions.

6.1. ADDITIONAL RESOURCES

ORACLE considers only recoverable components for aircraft and engines. But the PPB process must provide for many other resources in the budgets it produces. Examples of other resources are fuel, munitions, parts used in the repair of recoverable components (i.e., stock funded items), funds for modifications to aircraft and engines, ground support equipment, etc.

All resources should be balanced so that support for the operational forces is not lavish in one respect but penurious in another. For it is the least available resource that limits performance and not the average availability of all resources. Thus, it is necessary to understand how each resource affects operational performance measures. We can rather easily relate repair parts to the same aircraft availability measure we have used for components. A minor extension of the same measure should also work for fuel, since fuel can be thought of as a "part" of the aircraft that "fails" (is consumed) at a rate proportional to the amount of flying an aircraft does.

Munitions seem harder to deal with because there are so many different kinds, each with a different effectiveness against different targets. Thus, an aircraft does not actually require a particular munition to be "mission capable" against a given target; but which munitions are carried may affect the aircrafts degree of mission capability. Our present notions of operational performance assume that

an aircraft either is or is not mission capable, without considering degree. Modifications seem difficult for much the same reason as munitions. Of course, if a modification merely replaces some components of an aircraft with other, more reliable ones, and does not change the effectiveness of the aircraft against certain targets, then our present performance measure will capture the effect of the modification. But if the modification increases the capability of the aircraft in certain combat roles, the present performance measure is inadequate.

Research would be needed in this direction not only to define the needed relations between resources and operational performance. In addition, data sources must be identified and the problems peculiar to managing each individual resource must be understood.

6.2. OWRM AND THE ROLE OF THE WHOLESALE ECHELON IN WARTIME

6.2.1. The Present Situation

At present, the Air Force calculates its OWRM requirement using the LOGRAMS model, which is a simplified version of D041 adapted to accept a wartime scenario as input. LOGRAMS first estimates a wartime requirement for an item, a number large enough to support a worst-case composite scenario derived from all the scenarios in the WMP.[1] Then the POS and PWRM requirements (from D041 and D029, respectively) are

---

[1]The worst-case scenario determines the amount of flying that each aircraft type will do worldwide during each month of a 12-month war. During any month, the worst-case scenario will specify as many flying hours for an aircraft type as that type flies in the same month of any of the individual WMP scenarios. This flying includes training activity in the Continental United States (CONUS), and lines-of-communication (LOC) flying outside the primary combat theater--all flying, worldwide, that the aircraft may do.

LOGRAMS uses this scenario to drive its computation of wartime requirements in much the same way as D041 uses the peacetime flying program. Thus, LOGRAMS computes gross wartime requirements and applies assets against them. There is one category of assets available to LOGRAMS that is not available to D041, and these are assets derived from increased production of components in wartime. Thus, if the production rate of a component can be increased rapidly enough, LOGRAMS does not insist that stocks on hand at the start of the war be large enough to support the entire 12 months of fighting.

For any component, the maximum requirement observed in any of the 12 months, after netting out wartime production increases, is the wartime requirement estimated by LOGRAMS.

subtracted, and the residual is taken to be the OWRM requirement. (If the residual is initially negative, it is set to zero, so the total item requirement is large enough to support the more demanding of peacetime or wartime activities.) This approach seems to imply that the POS and PWRM requirement computations are of little more than cosmetic value, at least for those items whose total wartime requirement exceeds the sum of these two requirements strata. This is because any change in the POS or PWRM requirements will have no effect on the estimate of the total wartime requirement; and so, when the requirement for OWRM is estimated, it will change so as to exactly counterbalance the POS and PWRM changes.

In practice, however, it is more nearly true to say that the OWRM computation is treated as though it were cosmetic. Historically, OWRM requirements have hardly been funded, and this lack of OWRM funding can be expected to continue. For example, in AFLC's submission FY 1984 POM, the OWRM requirement for 1984 was stated to be about $1.1 billion. But AFLC asked for only $355 million in funding for that year. Thus in practice, changes in PWRM requirements, and even more, changes in POS requirements, can be expected to influence funding levels for components.

In the Navy, OWRM is calculated by multiplying a specified number of days by the demand rate of an item that the wholesale echelon expects to experience in wartime. The effect of this is to balance the stocks across the various items, so wholesale will not run out of one item long before it exhausts others. As in the Air Force, Navy OWRM requirements are not heavily funded, and the number of days of stock is adjusted so that the cost of buying stock will not exceed the funds available.

We feel that the LOGRAMS approach--that of comparing a total wartime requirement with the sum of POS and PWRM and taking the maximum--is a reasonable one. But there are two areas in which improvements are needed. First, it is not enough to consider only the stocks of spare components in determining OWRM. This is only part of the larger question of determining the role of the wholesale echelon in wartime. Many resources in addition to spare components should be considered as well.

Second, all components requirement calculations, whether for POS, PWRM, or OWRM, are based (in the Air Force) on a single scenario. For POS this seems reasonable, since the scenario--i.e., the peacetime flying program--is determined as a matter of policy. But for wartime requirements, especially OWRM, the proper scenario is not so easy to determine, as it is no longer a matter of policy to be decided during the PPB process. We think more investigation is needed of the relation between wartime scenarios and the wartime role of the wholesale echelon.

6.2.2. Tradeoffs Among Several Resources

As it stands, ORACLE estimates how the cost of buying and repairing spare parts is related to such programmed quantities as peacetime flying hours or the wartime scenario. Underlying these relationships are a host of assumptions concerning repair and transportation times, which parts are repaired at the base and which only at the depot, how soon in the event of war repair and resupply will be available to deployed units, etc. These assumptions might be changed if certain logistics-related policies were modified and if investments were made in resources other than spare parts (e.g., dedicated transportation). One direction for further research is, therefore, to investigate the tradeoffs between spares and other resources.

We have explored some ideas concerning tradeoffs between spares and other resources in another part of this project, undertaken in parallel with the construction of the programmer's database. The other part of the project involved the construction and use of the AWARES (Assessment of Wholesale And REtail Support) model, which is more fully described elsewhere. [13] Briefly, AWARES carries out a deterministic simulation of the component support system for arbitrarily many bases, weapon systems, and components, including common components and indentured components. The simulation traces the expected flows of components between the wholesale and retail echelons for any peacetime or wartime scenario. Any activities that generate requirements for components may be represented, including PDM and EOH activity.

Although AWARES will provide information on the flows of components to and from individual flight lines, its primary purpose is to provide information on the flows of components to and from the wholesale echelon. For any scenario, AWARES will calculate two such flows, a "maximum potential repair" flow, and a "minimum required issues" flow. Both flows are calculated for every item as functions of time for the duration of the scenario.

The maximum potential repairs of an item is the flow of failed components that arrives at the depot. These are items that fail at a flight line (or PDM line, or other activity) and cannot be repaired locally. So they are returned to the depot and arrive after a transportation delay. To these arrivals must be added any backlog of these items at the depot at the start of the scenario. The result is the maximum potential depot-level repairs, because the depot cannot repair more of an item than it has carcasses available.

The minimum required issues of an item measures the minimum support that the wholesale echelon must provide if the stated scenario is to be accomplished. That scenario includes not only stated activity rates but also minimum numbers of aircraft required to be available at each base and minimum stock levels to be maintained. The wholesale echelon is considered to be the source of last resort. If a flight line experiences a failure of item i, they will replace it only if not doing so will reduce their available aircraft below the required minimum. If they must replace it, they will initially try to obtain the replacement from local supply or local repair. Only if these sources fail will the wholesale echelon be asked to supply the item. And the wholesale echelon will ship it at the latest time that will allow it to arrive at the flight line by the time it is needed.

The wholesale echelon can supply the minimum required issues from one of three sources. First, they can issue the item from serviceable stock, if any is on hand. If the scenario is a wartime scenario, this stock could be OWRM. Second, they can repair a carcass, if the carcasses arrive in a timely manner. Finally, they can issue the item out of stock received from the contractor. Because these three sources are tapped to satisfy parts of the same demand, the three sources all interact, and should be considered together.

For any scenario, AWARES will calculate a minimum OWRM requirement. There must be enough OWRM stock so that when carcass arrivals at the depot are out of phase with demands, OWRM can tide the forces over until carcass generations catch up. There must also be enough OWRM to compensate for condemnations (to the degree necessary) until new production becomes available or the scenario ends, whichever occurs first. But these conditions merely establish a minimum for OWRM; additional OWRM might conceivably allow reductions in other resources that would more than cover the cost of additional stock.

For example, extra OWRM delays the moment that depot repair must begin repairing components, or equivalently, will allow the depot to reduce the maximum rate of repair of components. But it is this maximum rate that determines what capacity the depot must have in wartime to support the operating forces. If the maximum rate can be reduced--which is one consequence of owning additional stock--then smaller depot facilities will be adequate. Similarly, it may be possible for a contractor to gear up to produce ten widgets a day within 45 days after the start of a war, at great expense in standby equipment. It may be more economical to buy a few hundred extra widgets, and let the contractor increase production to ten widgets a day only after 90 days of war.

Not all instants in a scenario are equally demanding on the wholesale echelon, and the most demanding time is not the same for every item. The size of the OWRM stock, the capacity of the depot to repair items, and the capability of contractors to increase production in wartime must be geared to the worst instant. Even if all instants in the scenario were equally demanding, some tradeoffs among these three sources of wholesale stock could be made (e.g., an item may be repairable at considerable cost, but condemned and replaced from new production). With demands varying over time, even more possibilities open up for tradeoffs among these sources.

6.2.3. Planning with Multiple Wartime Scenarios

Although there are several scenarios described in the WMP, the Air Force bases its wartime component requirements calculation on only one scenario. This one is AFLC's "worst-case composite scenario," constructed so that (AFLC hopes) it will place at least as great demands on the component support system, and require at least as many of each component, as any of the actual WMP scenarios. This is not the place for a lengthy discussion of the advantages and disadvantages of this approach; it will suffice to say that knowing how well the Air Force can fight the composite worst-case scenario tells us little about how well it can fight the individual scenarios from which the composite is constructed.

Moreover, the WMP scenarios themselves are incomplete. They describe flying tempos and attrition rates by aircraft type and deployments of each aircraft type by theater. But they do not specify such parameters as wartime transportation times, repair availabilities, PDM schedules, and the like. When AFLC computes component requirements, they specify a single choice for each such parameter and estimate only the single corresponding requirement.

AFLC probably chooses these parameters as well as anyone can, and we do not criticize their choice or suggest that such parameters should be specified in the WMP. Rather, we are concerned that a single choice is made, both for the flying tempos and deployments and for support parameters. For all will agree that we do not know what the next war will look like with sufficient precision to tailor requirements to it.

We think a study should be carried out to determine how the support system can best be configured to cope with an uncertain wartime scenario. It will be especially important to consider not only investments in components but also investments in transportation, repair, and perhaps other resources as well, because it may cost a great deal more money than necessary to become able to support any of a range of scenarios, if the only option considered is buying spare parts. Supporting a range of scenarios may become affordable, on the other hand, if other options are considered, such as repairing more components at the intermediate level or reducing transportation times. AWARES

could be of some help in performing such tradeoffs. Moreover, once the support system configuration and resource levels have been tentatively determined, assessments should be done that pit the system against several individual scenarios. Here, assessment tools such as Dyna-METRIC will find application.

6.3. FORECASTING

In Sec. 5.3.1, we noted that the buy requirement shown in Fig. 5b has a huge spike in the first year after asset cutoff, and we attributed this to three sources. One was the carryover of requirements that had been identified but not funded in prior years. The second reason was that flying hour programs and other programs for the current and future years may be changed abruptly and in unanticipated ways. The third possible reason was that demand rates and other factors relating to individual components may change, again in unanticipated ways. For either of the last two reasons it may appear that the wrong components have been bought in previous years.

If hindsight tells us that much money has been spent on the "wrong" components in prior years, especially due to the third reason given above, then a very serious question is raised concerning the use of D041 (or its Navy counterpart) to provide information to the PPB process. For D041 computes the required buy in each year under the assumption that the right components will be bought in every prior year since asset cutoff. That is, in year 1, D041 assumes that the mistakes of history will be corrected and thereafter never made again. In Fig. 5b, for example, the year 2 buy requirement is only $50 million, assuming that the $1.3 billion requirement for year 1 is satisfied and that all the right components are bought. But if $1.3 billion worth of components is received, and in year 2 it turns out that only $900 million worth are the right components, then the year 2 requirement will be $450 million--$400 million to correct the mistakes of year 1 and $50 million in "new" requirements that we had already identified. (The numbers we have chosen are purely hypothetical.)

The problem is that no model we are aware of--not D041, the LCMS models, WARS, Dyna-METRIC, or the Navy models--has addressed the problem of forecasting requirements for future years. Nor is ORACLE better at

forecasting than these models, since it has been constructed to reproduce the results that would have obtained by a detailed computation by D041. All these models "forecast" requirements under the assumption that future values for all demand rates, repair times, and other parameters are completely known, and that future programs are also known. But all these quantities change over time in unpredictable ways (or ways that are at least partly unpredictable), so as time passes and the future approaches, new forecasts are made for the same years, and the new forecasts differ from the old.

In this section we will explore the implications of this phenomenon for the usefulness of ORACLE.

6.3.1 Implications of Unstable Forecasts

We argue that the implications of changes in the requirements forecast for a given year are different depending on whether the forecast changes because of program changes or requirements carried over from prior years, on the one hand, or because of changes in demand rates and other component-related factors, on the other. The first two are controlled by decisions, whereas the last is controlled by chance. The Air Force, or OSD, or Congress may decide how much of the requirement not to fund in a particular year, and hence how much is carried over to later years. The Air Force also decides what its flying programs shall be, and--within limits--what wartime scenario they should be prepared to fight. But in most cases, nobody controls or anticipates the failures per flying hour of individual components.

The purpose of ORACLE is to make visible the effects that decisions have upon requirements. In deciding whether to increase flying hours, one wishes to know the effect on the budgets of various years. In deciding which components not to fund this year, one wishes to know the effect on a weapon system's ability to perform in its wartime planning scenario. To the degree that D041 or LEVELS/STRAT accurately models the effects of programs or requirements, an ORACLE based on these systems will answer questions of this sort. Thus, if forecasts of requirements are rendered unstable by decisions to change programs or funding levels, this is merely proof of the need for an ORACLE, and does not reflect at all on its usefulness.

However, forecasts might also be unstable because demand rates, condemnation rates, etc., for many components changed frequently by significant amounts. These changes are unlooked for, and when they happen errors are introduced into the forecast made by D041 or LEVELS/STRAT. Given enough time, the error will grow sufficiently to make the forecast useless. When this point is reached, of course, an ORACLE based on D041 or LEVELS/STRAT becomes useless as well.

6.3.2. A Proposed Study

Thus, the implications of instability in the requirements forecast are quite different depending on the causes of the instability. We therefore propose a study that may help to determine the relative importance of the different causes.

The study would look at a time series of successive D041 forecasts. The D041 database involved in each would have to be retained, so it could be determined how much demand rates and other component-related factors had changed. The program inputs to D041 would also have to be kept, to determine how flying hours and the wartime planning scenario had changed. And a record of component purchases and repairs would have to be kept, to determine how much of an identified requirement had been deferred--carried over--to later years.

A study of this kind would require many years of data. Historical D041 databases are archived by AFLC, but their formats, and even the information they contain, have changed somewhat over the years as D041 has been modified.[2] Nonetheless, these old D041 databases are a source for component-related factors such as demands per flying hour, condemnation rates, etc. They also contain asset data, from which one might deduce what components were being procured. Procurement data might also be obtained from the J041 system.

[2]Modifications to D041 are another reason for forecast instability. However, they are anticipated, and tests are ordinarily run before the modification comparing the new method with the old. We need not further consider such examples of "controlled" instability.

Data on flying programs and depot-level maintenance programs are also found in the D041 database. These are not programs for end items but rather programs for individual components. The process of deriving the component programs involves multiplying the appropriate end item programs by the proper quantities per application and percent application, and summing over all end items to which the component applies. This process can undoubtedly be reversed, and the end item programs deduced from the component programs. These programs, along with the wartime planning scenario, might also be obtained from other sources.

But there are other kinds of programs to consider. Some, such as Foreign Military Sales (FMS), are reflected in additives to component requirements. Other programs, in particular modification programs, are reflected in the D041 database by percent applications that change over time. One might assume that instabilities in forecasts that arose from changes in percent applications from one D041 database to another were due to decisions to change modification programs. But it would be difficult to determine the reason for a change in an additive quantity.

We cannot, of course, anticipate just what the outcome of such a study would be. But we do point out that D041 has been used with reasonable success to determine what components to buy, and this involves forecasting requirements a procurement lead time--up to three years for some components--in the future. It seems likely that a forecast of one year beyond that would be safe to use in building or allocating budget for spare components. However, until a study of the kind suggested here has determined how fast the quality of the forecast degrades, we would not recommend relying on longer-term D041--or equivalently, ORACLE--forecasts.

6.3.3. Possible Extensions to ORACLE

The above discussion points out that there are programs for which this report has not developed ORACLE equations, such as modification programs and FMS. It might be possible to develop equations for the derivatives of requirements with respect to these programs, and to extend ORACLE in this way would enhance its usefulness. To develop FMS

derivatives, one would first have to identify additive FMS quantities of each component with the appropriate FMS case, and describe how those additive quantities would change if the FMS case were accelerated or stretched out, or if its size were increased or decreased. Similarly, to develop modification program derivatives, one must identify each component whose future percent application changes with the appropriate modification program, and specify how the changes would differ if the modifications were accelerated or decelerated, or if it were decided to modify a different number of end items. Adding these new data to D041 might be a major task.

Extending ORACLE to consider modification programs would encounter another problem as well. D041 estimates requirements for aircraft replenishment spares--the so-called Budget Program 1500--(as well as missile and support equipment replenishment spares), but not all of the cost of a modification program is funded out of BP1500. Thus, when the modification program is changed, some of the costs are not captured by the D041 computation. Some of these uncaptured costs are even for aircraft components, roughly those bought for *initial* installation in the modified aircraft. When a modification program is accelerated, it often happens that this part, at least, of the additional cost is paid out of the BP1500 account.

A similar phenomenon can be observed in the relation between BP1500 and the Initial Spares budget program, BP1600. Both programs buy the same resource--spare aircraft components. It is an accounting convention, although for some purposes a useful one, that causes two separate requirements to exist for the same resource, or even three requirements when one considers the aircraft components bought as part of modification programs.

It would be desirable to extend ORACLE to deal with all requirements for aircraft components, no matter out of which budget program they are funded. This would require that all of these requirements be included in D041, wherever the requirements are actually calculated. At the present time, the author does not know how difficult it would be to effect the change in AFLC procedures.

6.3.4. Flexibility

As we pointed out earlier, the purpose of ORACLE is to provide high-level managers with estimates of the effects of their decisions on budgetary and program quantities. If the estimated cost of the program is different in the budgeting stage than it was at the time of the POM, there must be flexibility and guidance to adjust the program so that its cost will not exceed the budgetary limits imposed by the White House. If the budget enacted by Congress does not agree, by appropriation category or in total, with the budget submitted to them, the services must have the flexibility to adjust the program. Finally, if the budget fails to buy as much as anticipated, due to unforeseen changes in prices, usage rates, and the like, the people who execute the budget must have the flexibility to adapt to the changed circumstances.

The ORACLE database could provide some of this flexibility, because it would be updated frequently to reflect changes in the state of the world, and because it is designed to allow users to manipulate the program and observe the effect on estimated resource requirements. We have pointed out the possibility that D041 forecasts of POM requirements may be poor enough that ORACLE should not be used (at least provisionally) in the programming stage of the PPB process. Also, ORACLE does not contain detail at the level of individual aircraft components. But it could provide some flexibility during the high-level--i.e., "strategic"--control of execution.

At a more detailed level of execution, managers need an execution tracking and control system to help determine which components are in critically short supply and to suggest methods to work around critical shortages. To do this, a tool is needed that relates aircraft availability in peacetime and wartime to parameters that describe components, such as the assets on hand, repair times, demand rates, etc. Such a tool is Dyna-METRIC [5], a model developed at Rand.

The Air Force has contracted for the development of the "Combat Analysis Capability (CAC)" system. Under CAC, weapon system managers will be given access to Dyna-METRIC, and the databases needed by Dyna-METRIC will be assembled and kept current. As a tool for day-to-day management, it can provide the kinds of information needed to

pursue the stated goals of wartime operational capability. Instead of supply-oriented information related to the current, peacetime situation (how many widgets are currently backordered?), Dyna-METRIC provides measures of the wartime capability of the operating forces (how many aircraft can I expect to have available after a week of war?); and Dyna-METRIC also provides measures of how badly a component shortage hurts (if I lose two more widgets, how many more aircraft can I expect to be grounded?)

Day-to-day managers have a number of policy levers at their command to cope with specific component shortages. For example, they can redistribute stock among flight lines, or from wholesale to other echelons. By providing for dynamic, real-time redistribution, they can reduce the need for safety stock; the portion of safety stock that becomes "excess" can now be used to fill pipelines. Redistributions beyond the safety levels cut into WRM stocks and reduce wartime capability in favor of peacetime activity.

Or they can affect key factors that influence component availability, such as transportation or repair times, by assigning high priority to the components that are short. The processing of components through supply and maintenance organizations is expedited; they can travel by air instead of ship, train, or truck. These measures reduce the time a component spends in the pipelines and hence reduce the number of components in the pipelines. Base maintenance personnel may work overtime to expedite the repair of critically short items. Pilots, knowing that an item cannot be replaced, may fly an aircraft with that item working poorly or not at all, thus reducing the item's apparent failure rate. However, close attention can be given to only a limited number of components. Thus, it is important to have a system such as CAC to single out the components that are in critically short supply and devote special management attention to them.

These developments should increase the ability of AFLC to deal flexibly with some resource shortfalls, but surely some possibilities have not been fully explored. For example, it might be possible to incorporate features such as partial redundancy into the next generation

of aircraft, or into modified versions of today's aircraft, so that aircraft performance degrades more gracefully in response to resource shortfalls. We suggest, therefore, that some further research be aimed at increasing flexibility in logistics support.

Appendix A

SIMPLIFICATIONS EMPLOYED IN CONSTRUCTING THE TEST VERSION OF D041

A.1. GENERAL DISCUSSION

We have constructed the prototype ORACLE database to "mimic" a special test version of D041, a test version built especially for this purpose. In building the test version of D041, we have made numerous simplifying assumptions. We have assumed that demand rates, transportation and repair times, and other item-related factors remain constant over the entire span of D041's requirements projection. We have assumed that the wartime scenario parameters are also the same in each year of the projection and that the scenario takes a particularly simple form. And we have considered only items that are installed directly on a single end item--i.e., no item common to two or more end items (common items), and no item whose failure is discovered during the repair of another item of which it is a part (indentured items).

Of all these simplifications, only the exclusion of common and indentured items might be difficult to undo. If the item-related factors depend on time, the equations of Sec. 4 become messier but conceptually no different. If the wartime scenario becomes more complicated, the equations of Sec. 4.6 must be revised and new equations added to calculate derivatives with respect to the new scenario parameters. But the methods used in Sec. 4.6 for the equations there now will also work for the new and revised equations.

Common and indentured items, however, cannot be dealt with so easily. In this appendix, therefore, we suggest what changes may be necessary to include these items in the test version of D041. Before doing so, however, we stress that the failure to deal with common and indentured components is a lack of the test version of D041 and not a shortcoming of the ORACLE methodology that mimics D041. Indeed, if the test version of D041 were modified as suggested in this appendix, the ORACLE methodology could easily be modified to mimic it.

A.2. COMMON COMPONENTS

A.2.1. Pipeline and Operating Requirements

There is no particular problem in computing the pipeline and operating requirements of common components, or in aggregating these requirements to the weapon system level. In Sec. 4.4, in fact, it was notationally more convenient to write all equations for pipeline and operating requirements as though an item could have applications to several end items. The only feature distinguishing a common item from one peculiar to a single end item is that the former has two or more end items k for which QPA(i,k) is not zero, whereas the latter has only one nonzero QPA(i,k).

Even if an item's order-and-ship pipeline requirement, BOSR(i,y) (Eq. (5)), for example, is not due to the activity of a single end item, still the requirement breaks naturally into pieces that are due to the individual end items. Each such piece can be identified and will make its contribution to OSTF(k) (Eq. (21)) for the appropriate end item k. (In fact, Eq. (21) remains correct even when applied to common items.) It will remain true that one can compute the total dollar value of the various pipelines and operating requirements by multiplying aggregate factors such as OSTF(k) by end-item programmed activities; and this procedure will yield the same result as would carrying out an item-by-item computation of the same terms and then aggregating.

We have heard arguments that the item-by-item computation done by D041 of pipelines and operating requirements is incorrect for common items because it assumes that demands per unit activity, pipeline lengths, and all other factors are the same for all applications of the item. This criticism may well have merit, and if it does the same criticism may be made of the aggregate approach discussed here. All we claim is that the aggregate approach does not introduce any additional error.

A.2.2. OIM Safety Levels

Common items can cause difficulties in the computation of safety levels. In Problem (23) of Sec. 4.5, we have considered only a single weapon system. If we consider several, which ORACLE must, then each weapon system will contribute its own constraint to Problem (23), with its own target FMCS level and target probability of achieving it. If an item is peculiar to one weapon system, the safety levels for that item will appear in only one constraint. But the safety levels for an item common to two or more weapon systems will appear in the constraints of every weapon system to which it applies. This will tie together the capabilities of the weapon systems. In principle, the optimal safety levels can still be found but to do so requires a significantly more complex algorithm, both for computing the safety levels themselves and for computing their derivatives with respect to programmed quantities.

We recommend, therefore, that the effect of common items be approximated as follows. If an item is common to two weapon systems, define two variables for each of item safety levels, one to be assigned to each of the weapon systems. This "fencing" of requirements is probably appropriate for the base safety level, since these are fenced by user as it is. But the wholesale safety level supports all users. To adjust for this, one may judiciously select a variance-to-mean ratio for portions of the wholesale safety stock assigned to the various weapon systems. These portions actually form a single pool of stock, but we may consider that they form two pools that are perfectly correlated. (Actually, they need only be connected sufficiently that they are always exhausted simultaneously, but this is accomplished by perfect correlation.) We let:

WMEAN(1), WMEAN(2) = the mean pipeline quantities associated with the two weapon systems. Recall that these are computed using Eq. (7) of Sec. 4.4, and that there is no difficulty in calculating separate means for individual weapon systems, even for common items.

The variance of the entire wholesale pipeline for this item is:

$$WVAR = VTMR * (WMEAN(1) + WMEAN(2))$$

We will split this single pool of stock into two pools in proportion to the two means. Each pool is represented by a random variable, and the sum of the two random variables must have the same distribution that the entire pool has. We assume that both pools have the same variance-to-mean ratio, but because the pools are perfectly correlated, that ratio will be different from VTMR; let us call it VTMR'. Then the variances of the two pools are:

$$WVAR(1) = VTMR' * WMEAN(1)$$

$$WVAR(2) = VTMR' * WMEAN(2)$$

If the two pools were uncorrelated, the variance of their sum would equal the sum of the individual variances. But because they are perfectly correlated, this is no longer true. Instead, the standard deviation of their sum equals the sum of the individual standard deviations (the standard deviation being the square root of the variance). Thus, we can calculate VTMR' as:

$$VTMR' = \frac{WVAR}{[SQRT(WVAR(1)) + SQRT(WVAR(2))]^2}$$

Once this adjustment is made, the common item can be dealt with as if it were two separate items, each peculiar to a different weapon system. This procedure can easily be generalized to items common to any number of weapon systems.

This procedure is only an approximation. Obviously, if one treats common items as common and does not split them into pools dedicated to individual weapon systems, the support given an item, measured in terms of the item fill rate, will be the same for all weapon systems to which it has application. If the common item is split into pools, and if it should happen that the optimal solution shows the fill rate of an item from each pool to be the same, then the two methods will have given the

same result, Generally, however, the different pools will have different fill rates, and in this case dividing the item into weapon-system-specific pools will have introduced an error. The weapon system for which the item has the higher computed fill rate would in practice experience the lower fill rate that would be common to all applications of the item; and conversely for the weapon system for which the item has the lower computed fill rate. The former weapon system would receive somewhat poorer support than intended, while the latter weapon system would receive somewhat better support. This assumes, of course, that neither weapon system has an advantage over the other in receiving support for this item. If a priority scheme could be devised that gave the former weapon system just the right degree of precedence over the latter, the practical results could be made to match the mathematics.

A.2.3. Prepositioned War Reserve Materiel

There is no difficulty in computing PWRM requirements for common items, even though the problem to be solved in computing PWRM requirements is very similar to the problem of determining safety-level requirements. Each user of a weapon system has his own individual PWRM authorization, which is computed without regard for whether an item is also applied to a second weapon system. This is because, during the period when the authorized PWRM stocks are to provide support to a user, he is assumed not to receive any other support, so his PWRM must be computed to meet his demands, independent of the demands that any other user may experience.

Common items do differ in one respect from items peculiar to a single weapon system. They will have a PWRM authorization calculated for several weapon systems, and these several authorizations must be added to determine the total requirement. Also, the common item PWRM requirement will have nonzero derivatives with respect to the scenario parameters of several weapon systems. But the method for computing the requirement and its derivatives will be the same for common items as for peculiar items.

A.2.4. Application of Assets

During asset application, common items need not be dealt with any differently than peculiar items. The fact that the programmed activities and capabilities of several weapon systems affect a common item's requirement merely means that the common items will contribute to more of the aggregated derivatives than will a peculiar item. But the equations for asset application work for either kind of item.

A.3. INDENTURED ITEMS

A.3.1. Pipeline and Operating Requirements

Computing pipeline and operating requirements for indentured components presents no difficulties in principle. D041 has no access to data that distinguishes components from subcomponents at base level. Instead, the removals of a subcomponent, even though they occurred at an intermediate maintenance facility, are recorded as removals from the ultimate end item. The OIM demand rate for a subcomponent is calculated as total removals divided by the activity of the ultimate end item, rather than divided by the activity--i.e., number of repairs--of the parent component.

At the depot, D041 data do reflect indenture. The number of an item to be repaired is that item's MISTR program, and demands for its subcomponents are assumed to occur in proportion to that program. But the MISTR program of the original item was estimated in D041 by reference to the programs of the end items to which it is applied, or (if the item itself is a subcomponent of yet another item) by reference to the MISTR programs of other items which in turn depend on end-item programs. By following the chain of items in an indenture structure, one can always allocate an item's MISTR program to end-item programs. Computationally this is a cumbersome process, but it presents no theoretical difficulty and involves no approximations. Indeed, this is implicitly what happens at the base level when subcomponent demands are related back to end-item programs.

A.3.2. OIM Safety Levels

Computing safety levels for indentured items presents some difficulties. The problem here is that when a subcomponent is backordered, it may only be holding its parent component in AWP status, and not making an aircraft NMCS. Only if the parent component is also out of stock will a shortage of subcomponents have an effect on aircraft availability.

In the current system, a subcomponent drops from view when installed on its parent component. But it is possible to infer the quantities and flows of these hidden subcomponents by observing the quantities and flows of the parent component. We think it possible to preprocess the D041 database in certain ways, then carry out the requirements computation as if all components, indentured or not, are installed directly on the aircraft, and finally to postprocess the results to obtain the proper subcomponent requirements. The preprocessing step must:

- Adjust subcomponent repair times. The time spent working on a parent component to isolate the failed subcomponent must be added to the present subcomponent repair time, at both base and depot.
- Adjust subcomponent assets. If there are, say, two of a subcomponent installed on each parent component, and there are ten serviceable parent components in stock at a base, the serviceable subcomponents at the base must be increased by 20. Similarly, if a parent component fails and enters base repair, and on average 70 percent of the subcomponents are discovered to have failed, the remaining 30 percent (in this case 0.6 items) must be added to serviceable stock. (The numbers of subcomponents to fail is already estimated correctly, so no adjustment to them is required.)
- Adjust parent component purchase prices. In the present procedures, when a requirement is estimated for a parent component, it is assumed that the parent will bear a full complement of subcomponents. Since we are pretending that

subcomponents are entirely separate from parent components, the subcomponent requirement will be increased by the numbers normally installed on parent components, and the dollars to meet this extra requirement will be estimated separately from the parent component. To avoid double counting of the dollars, the price of a parent component must be reduced by the purchase price of a full complement of subcomponents. This could lead to problems if the residual price of the parent component becomes small or even negative. But we do not know whether this would occur frequently in practice.

The postprocessing step is intended to take the subcomponents made visible by the preprocessing step and once again hide them in the bellies of their parent components. This step must:

- Reduce the subcomponent buy requirement by the amount that will be bought automatically as part of the buy of parent components. Problems may arise if the buy of parent components exceeds that of subcomponents, but we do not know how frequently this may occur in practice.

A.3.3. Prepositioned War Reserve Materiel

Since the problem of estimating PWRM requirements is so similar to the one of estimating safety levels, the same adjustments can be made to account for indentured components.

A.3.4. Application of Assets

There is no need to treat indentured items any differently from other items during asset application. The same equations work for all items.

Appendix B

OIM SAFETY LEVELS

B.1. METHODS PRESENTLY USED FOR COMPUTING SAFETY LEVELS

The base and depot OIM safety levels are intended to prevent random variation in demands from grounding aircraft or necessitating the use of war reserve stocks to support peacetime activities. It is not possible to provide absolute protection with a finite budget, so the problem of calculating safety levels becomes one of determining the combination of items that will provide the greatest level of protection for a given amount of money, or equivalently, a given level of protection for the least amount of money. Clearly, how one wishes to calculate safety levels will depend on how one measures the level of protection, or to put it another way, on how one measures the performance of the component support system.

The basic notion underlying all methods for computing peacetime safety levels is that the numbers of items in the base-related and depot-related OIM pipelines in peacetime are random. In Sec. 4.4.1, we estimated the expected values of these numbers, but the observed value at any time is unlikely to match the expected number. There will be periods in which removals of an item at the flight line exceed expectations, and during the intervals immediately following these periods, the pipelines will contain more items than usual. The safety stocks are intended to provide this incremental pipeline content. Were it not for safety stock, this increment would have to come from war reserve materiel or stock on the aircraft themselves.

The simplest method to calculate safety levels, and the first one used in practice, is the "fixed safety level" method. With this method, each part is treated in isolation from all other parts. Each component's safety level is made large enough to provide some specified probability that the item will be in stock at the base, and the same probability it will be in stock at the depot. The probability an item is in stock is the probability that a requisition for the item can be filled immediately upon receipt and is called the "fill rate" for that

item. The fixed safety level of an item is proportional to the square root of the expected number in a pipeline. By varying the proportionality constant, one can vary the probability that an item is in stock. For the base safety level, there is an additional feature. The base level OIM pipelines are split among a number of identical users (e.g., squadrons), so the total pipeline is first divided by the number of users, then the square root is taken, and the result is finally multiplied by the number of users.

At the next level of sophistication, one finds the "variable safety level" (VSL) method. Underlying this method is the assumption that whenever an item is demanded but out of stock, something bad has happened, such as an aircraft being grounded or an item being withdrawn from a war reserve stockpile. When an item is demanded but is not in stock, it is backordered. The VSL method tries to minimize the number of bad happenings by buying the combination of items that minimizes the expected number of backordered items, subject to the total expenditure being within the available budget. It is considered just as bad for a 10¢ washer to be backordered as for a $100,000 fire control computer, and since one can buy a lot of 10¢ washers for the price of a computer, this method has a strong tendency to buy higher levels of protection of inexpensive items than for expensive ones.

Both the fixed and variable safety-level methods are presently used in D041. The fixed safety-level method is used during the initial computation of the quarterly cycle, and the variable safety-level method is used--for most items--in the final computation. However, efforts are currently under way to replace the use of the VSL method in the final computation by an "aircraft availability" method. Because this appears to be the method of the future--it is the one adopted for use in WARS and also has been for implementation in D041--we have implemented an "aircraft availability" method for computing safety levels in our text version of D041.

B.2. AIRCRAFT AVAILABILITY SAFETY LEVELS FOR SINGLE ITEMS

The "aircraft availability" method attempts to assess the effect that a particular instance of stockout will have on the number of aircraft available to fly. We assume that war reserve stocks will not be drawn upon, and that all additive stocks and negotiated levels are being used for whatever purpose originally justified them, so that only the expected pipeline contents plus the safety levels are available to satisfy demands. We must also make an assumption concerning cannibalization, and here there are two extreme possibilities. One may assume there is no cannibalization, which is what the regulations say, or one may assume that cannibalization actions occur whenever they can make an additional aircraft available--the "full cannibalization" assumption. No doubt the truth is in between. Our test version of D041 uses the "full cannibalization" assumption, and we understand that the modification to D041 presently taking place will use the "no cannibalization" assumption. For completeness we present both methods here.

First we must develop the expressions that relate the size of the safety level to available aircraft. Let us consider a squadron consisting of A identical aircraft of type k (k is the index of the appropriate end item).[1] Suppose for an item i there is a deficit of h(i)--i.e., the number of items i actually in the pipeline at a particular instant exceeds the expected number plus the safety level by h(i). If withdrawals from WRM or other purpose stock are not allowed, this deficit will translate into h(i) holes left in the A aircraft.

Let us first consider the no-cannibalization case. In this case, we make the assumption that each hole is equally likely to be on any aircraft, and for items of which there are more than one per aircraft, equally likely to be at any of the slots where the item is normally installed. The total number of slots for item i (call them i-slots) is A * QPA(i) (this is QPA(i,k) with the index k omitted), so the probability that any particular i-slot is filled is (1 - h(i)/(A *

[1] In the remainder of this appendix, except for a reminder at the very end, we will omit the index k to simplify the notation. The reader must understand it to be implicitly present where appropriate.

QPA(i))), and the probability that a particular aircraft has all of its i-slots filled (i.e., is fully mission capable for item i, or FMC(i)) is:

$$\text{(B.1)} \quad PN(FMC(i) \mid h(i)) = \left[1 - \frac{h(i)}{A * QPA(i)} \right]^{QPA(i)}$$

(the notation PN denotes "Probability with No cannibalization").

And, since we assume that unfilled slots of different items are uncorrelated, the probability that a particular aircraft will have no holes (i.e., will be fully mission capable for supply) is the product of the probabilities that it will have no holes of each type. That is:

$$PN(FMCS \mid h(1), h(2) \ldots) = Prod[PN(FMC(i) \mid h(i)) \mid \text{all } i]$$

Now let:

p(h,i) = the probability of finding h holes of item i. This quantity depends on the safety levels at both base and wholesale echelons, as we discuss later.

We assume that the numbers of holes of different items are uncorrelated, so that the probability of having h(1) holes of item 1 and h(2) holes of item 2 ... etc., is just the product of p(h(1),1) and p(h(2),2) ... etc. Given these probabilities and the above expressions relating holes to aircraft availabilities, we can estimate the expected fraction of aircraft that have no holes (i.e., are FMCS) as:

$$EN(FMCS) = Sum\{Prod[p(h,i) * PN(FMC(i) \mid h(i)) \mid \text{all } h(i)] \mid \text{all } i\}$$

Because of our zero-correlation assumptions, all terms relating to a single item i can be factored out of this expression, and treated separately. Thus, we define the expected fraction of aircraft that will be fully mission capable for item i (i.e., are FMC(i)) to be:

(B.2) EN(FMC(i)) = Sum(p(h,i) * PN(FMC(i) | h) | all h)

Then, the expected fraction of FMCS aircraft is:

EN(FMCS) = Prod(EN(FMC(i)) | all i)

In calculating safety levels using the aircraft availability method assuming no cannibalization, one wishes to buy the combination of items that maximizes EN(FMCS) while not exceeding the stated budget, or equivalently, minimizes the cost of all the items while meeting a stated level for EN(FMCS).

It is possible to use the function EN(FMCS) as the measure of aircraft availability to be maximized in calculating requirements for safety levels. Indeed, the LCMS models do so. But because it assumes no cannibalization, the function EN(FMCS) can be criticized as being too pessimistic a measure of the quality of support provided to a weapon system by the component support system. (In some ways, the measure is optimistic, since it pays no heed to factors other than components that might ground aircraft. These other factors must be considered in coordination with components to achieve a balanced support posture. Here, however, we are considering only the component-related part of the larger problem.) One can argue that, regardless of whether cannibalization does or does not occur, holes in aircraft will not be distributed randomly among aircraft. If two aircraft are grounded for the same part A, and one of them is also down for a second part B, when part A arrives at the base it will be installed in the first aircraft, which would thereby be made FMCS, and not in the second, which would remain NMCS. By judiciously choosing which aircraft to repair, holes will tend to be concentrated on fewer aircraft than the function EN(FMCS) would predict. Moreover, if substantial numbers of aircraft were grounded, one would expect some deliberate cannibalization to occur. Thus, as an alternative to EN(FMCS), one might wish to use a performance measure that assumes some degree of cannibalization. Mathematics being what it is, it is easier to assume complete cannibalization--i.e., that holes are concentrated on the fewest

possible aircraft--than it is to assume any lesser degree of cannibalization.

Using the same notation as earlier, we let h(i) be the number of holes for item i in a squadron of A aircraft. Then, the smallest number of aircraft that can be grounded by these holes is the maximum over all items i of the ratio h(i)/QPA(i). For any item, this ratio is the smallest number of aircraft on which the holes for the item can be concentrated. One item will hold down more aircraft than any other, and we can concentrate all holes for all items on the same aircraft that are held down by that one critical item. Thus, the probability that a particular aircraft will be FMCS under a full-cannibalization policy, given holes h(1), h(2), etc., for the various items is:

$$\text{(B.3)} \quad PC(FMCS \mid h(1), h(2), \ldots) = 1 - \frac{Max(h(i)/QPA(i) \mid \text{all } i)}{A}$$

Given the probabilities p(h,i) from before, calculate the probabilities of finding different numbers of aircraft grounded under the full-cannibalization assumption. The probability that there are no more than H holes because of item i is:

$$\text{(B.4)} \quad P(H,i) = Sum(p(h,i) \mid 0 \le h \le H)$$

And, again assuming that the number of holes of each item is uncorrelated with the numbers of holes of all other items, the probability that no more than a fraction TFMCS of the aircraft are grounded for any item is:

$$\text{(B.5)} \quad PC(TFMCS) = Prod(P(A * QPA(i) * (1 - TFMCS), i) \mid \text{all } i)$$

Using the probabilities PC(TFMCS), one can compute the fraction of aircraft expected to be FMCS under the full cannibalization assumption. The result is:

$$EC(FMCS) = \int_0^1 (1 - PC(TFMCS))\, dTFMCS$$

Unfortunately, this function, unlike EN(FMCS) and PC(TFMCS), does not factor into parts each of which involves only one item, and maximizing it to compute safety levels results in a problem that is much harder to solve. But the function PC(TFMCS), defined by Eq. (B.5), does factor into item-specific parts. The use of PC(TFMCS) in the computation of safety-level requirements results in the problem of minimizing the cost of ensuring that no more than a fraction TFMCS of the aircraft are grounded with a target probability TPROB. Instead of one parameter, TFMCS, the aircraft availability measure has two, TFMCS and TPROB.

There seems no theoretical reason to choose one of these formulations over the other. If the assumption of no cannibalization is too pessimistic, the assumption of full cannibalization is no doubt too optimistic. On practical grounds, also, it seems a toss-up. The methods should be equally easy to implement, and neither one has been finally selected over the other. The LMI Aircraft Availability Model, which is part of LCMS, assumes no cannibalization, and its performance measure, EN(FMCS), is the one chosen for implementation in D041. On the other hand, Dyna-METRIC has assumed full cannibalization in most of its applications. Furthermore, D029, which computes prepositioned war reserve materiel requirements also assumes full cannibalization.

We have chosen to implement the full cannibalization assumption in our test version of D041, but we will present in parallel all of the modifications that would be required to implement the alternative assumption.

B.3. PROBABILITIES OF FINDING HOLES IN AIRCRAFT

Regardless of which assumption is selected, it is necessary to relate the probabilities p(h,i) to both base and wholesale safety levels. To do this, one must first specify the statistical distribution that describes the likelihood of finding different numbers of items in the OIM-related pipelines. A common assumption is that the form of the distribution is Poisson. To completely specify this distribution, it is only necessary to give its mean, which we calculated in the previous section (Eqs. (5)-(7) from Sec. 4). However, the variance of a Poisson distribution always equals its mean, and it has been observed that the pipeline contents do not always obey this rule. The form of the distribution selected should admit variance-to-mean ratios other than one.

There are numerous distributions that satisfy this criterion. A compound Poisson distribution is often selected, but in this report we will assume a Normal distribution. It has many nice, well understood properties, including the one that, once the expected number of items in a pipeline becomes substantial (e.g., ten or so), many other distributions closely resemble the Normal distribution with the same mean and variance. The Normal distribution does have the drawback that it is a continuous distribution. That is, it assigns a nonzero probability to the event that a fractional number of components is in the pipeline. This can be circumvented by considering that all numbers between N - 1/2 and N + 1/2 will be interpreted as equivalent to the integer N. The Normal distribution also assigns nonzero probabilities to negative values of the pipeline content. In most instances, this can be overcome by truncating the distribution. We denote by f(x) the probability density function for a Normal random variable with zero mean and unit variance, and by F(x) the cumulative distribution for the same variable. That is:

$$f(x) = \frac{1}{SQRT(2 * PI)} * \exp(- x^2/2)$$

$$F(x) = \int_{-inf}^{x} f(y)dy$$

We first discuss the link between the probabilities and the base safety levels, assuming that the wholesale echelon is always able to fill requisitions sent from the base (we will later relax this assumption). At base level, we assume that the safety stock is divided among a number of identical users, each of whom subsists on his own stock without support from other users. There is actually some support between users, called "lateral support," but it is official policy in both the Air Force and the Navy not to rely on it. In developing our prototype, we have discounted this possibility. We let:

USR(i,y) = number of users of item i during year y following asset cutoff.

Then the mean number of items per user in the base pipelines is (using Eqs. (5) and (6) from Sec. 4):

$$BMEAN(i,y) = \frac{BOSR(i,y) + BRCR(i,y)}{USR(i,y)}$$

We assume that the variance-to-mean ratio, VTMR, for each item is known. For simplicity, we have made this parameter the same for every item in the prototype programmer's database, although this assumption is not necessary to make the method work. Thus the variance in the base pipeline content is:

$$BVAR(i,y) = VTMR * BMEAN(i,y)$$

As before, we let BSSR(i,y) be the base safety-stock requirement. Then the probability that a given user suffers no more than H holes for item i, given no wholesale backorders (denoted P(H,i | WBO = 0)) is the probability that the actual pipeline content does not exceed the expected content plus the safety stock by more than H. Thus:

$$(B.6) \qquad PB(H,i \mid WBO = 0) = F\left[\frac{BSSR(i,y)/USR(i,y) + H}{SQRT(BVAR(i,y))}\right]$$

Equation (B.6) only estimates the likelihood that a user will suffer H or fewer holes under the condition that there are no wholesale backorders. If the number of wholesale backorders, WBO, is larger than zero, presumably the user is likely to suffer more holes. To estimate the effect that wholesale backorders have on the number of holes suffered by a user, we argue as follows.

Let us suppose that a user requisitions an item from the wholesale echelon, and that wholesale, being out of stock, issues a backorder instead of a serviceable item. If an item had been issued, it would now be in the order-and-ship pipeline, which is part of the pipeline content for that user. Since the item was not issued, there is a "hole" in the user's pipeline.

A typical order-and-ship time is 14 days. Thus, for 14 days the "hole" created by the new backorder will remain a hole in the pipeline. It cannot reach the flight line and affect aircraft until the 14 day order-and-ship time is completed. (If the reader is uncomfortable with the idea of holes moving through pipelines, one may explain this another way. If a serviceable item had been sent instead of backordered, it could not have reached the flight line for 14 days. Thus, the status of the flight line is the same for 14 days whether or not an item is shipped.) After 14 days, the hole pops out of the pipeline, either onto the supply clerk's shelf or into an aircraft. The hole will migrate

back and forth between shelf stock and aircraft, depending upon whether or not the user's pipeline content is small enough to be covered by his on-hand stock. When the wholesale echelon finally fills the backorder, they put a serviceable item into the order-and-ship pipeline. Again, it takes 14 days before the serviceable asset pops out of the pipeline and annihilates the "hole" at the flight line.

Thus, the effect of a backorder is to reduce the user's effective stock by one item for the duration of the backorder, but for an interval of time shifted by an order-and-ship time relative to the interval during which the backorder is on the books. Thus, the generalization of Eq. (B.6) for arbitrary numbers of wholesale backorders is:

$$\text{(B.7)} \quad PB(H,i \mid WBO) = F\left[\frac{(BSSR(i,y) - WBO)/USR(i,y) + H}{SQRT(BVAR(i,y))}\right]$$

This expression implicitly assumes that the amount of stock in the user's pipelines is uncorrelated with the number of backordered items. But as we discussed earlier, if the number of backorders, or especially the number of holes in aircraft, becomes high, base-level maintenance personnel may be provoked to repair items faster by working overtime; pilots may be willing to overlook some minor faults in aircraft and thus temporarily reduce the apparent failure rate of the item; and the item manager may expedite the transportation or repair of this item, or of its subcomponents or repair parts, or of a parent component. All of these possibilities are ignored by D041, as well as by the Navy methodology, the LCMS models, WARS, and to a large extent by Dyna-METRIC.

There is another reason that the numbers of items in the user's pipelines might be correlated with the number of wholesale backorders. The number of items in the user's pipelines is driven by the failures of items at his base during a time interval equal to the length of the longest base pipeline, which is the order-and-ship pipeline. The number of items in the wholesale pipeline is driven by the failures at all bases, for a length of time equal to the total depot repair cycle time.

The failures that drive the individual user's base pipelines are among the failures that drive the wholesale pipeline. Thus, one would expect some correlation between the two. And since wholesale backorders will occur when the wholesale pipeline content becomes large, there should also be a correlation between backorders at wholesale and large pipeline contents at an individual base.

But typically, the depot repair cycle time is much longer than the order-and-ship time (46 days as compared to 14 for the item in Table 1). Further, an item typically has many users. Thus, the failures that drive the individual base pipelines are only a small part of the failures that drive the wholesale pipeline, and backorders at wholesale should have little correlation with the user's base pipeline contents.

To compute the probabilities P(H,i) of Eq. (B.4), we must "uncondition" the probabilities PB(H,i | WBO) from Eq. (B.7). This requires that we know the probability that there will be WBO backorders at wholesale. But there will be WBO backorders precisely when the number of items in the wholesale pipeline exceeds the expected number plus the wholesale safety stock by WBO. The distribution of items in the wholesale pipeline is Normal, with mean (from Eq. (7), Sec. 4) and variance (by analogy with the variance of the base pipeline distribution) of:

$$\text{WMEAN}(i,y) = \text{DORCR}(i,y)$$

$$\text{WVAR}(i,y) = \text{VTMR} * \text{WMEAN}(i,y)$$

The probability of having no more than WBO backorders is:

$$\text{(B.8)} \qquad \text{PW}(\text{WBO},i) = F\left[\frac{\text{WSSR}(i,y) + \text{WBO}}{\text{SQRT}(\text{WVAR}(i,y))}\right]$$

where as before, WSSR is the wholesale safety stock. Then, to compute P(H,i) (Eq. (B.4)) we have (where "inf" denotes "infinity"):

$$\text{(B.9)} \quad P(H,i) = \int_{0}^{inf} PB(H,i \mid WBO) * \frac{dPW(WBO,i)}{dWBO}\, dWBO +$$

$$+ PB(H,i \mid WBO = 0) * PW(WBO = 0,i)$$

This expression is messy, the integral in particular being difficult to evaluate. Thus, we consider two simplifications, one of which provides an optimistic estimate for P(H,i), and one a pessimistic estimate.

The optimistic estimate arises from a change in our underlying assumptions that is suggested by the resemblance of Eq. (B.9) to a convolution. If the term for WBO = 0 were replaced in Eq. (B.9) by the other half of the integral, namely, between the limits WBO = -inf to WBO = 0, the result would be a convolution. This convolution would be exactly what one would obtain under the assumption that the wholesale echelon will fill holes in aircraft, even if it means giving a user more stock than he is authorized. We have been assuming that the wholesale echelon will issue stock to a user only if the user returns a failed item to wholesale, the so-called (s, s - 1) inventory policy. Under this policy, the user's base pipelines may become larger than the sum of the expected pipeline content plus the user's base safety stock. Under the (s, s - 1) policy, the excess pipeline content must come from aircraft (since we prohibit dipping into WRM stock). Under the more relaxed policy, it could come from wholesale.

The mathematical advantage of the more relaxed assumption is that the convolution it gives rise to is easy to evaluate. The resulting expression for P(H,i) is:

$$\text{(B.10a)} \quad P(H,i) = F\left[\frac{\dfrac{BSSR + WSSR + H * USR(i,y)}{2}}{SQRT(USR(i,y) * BVAR + WVAR)}\right]$$

This formulation overestimates the probability that there will be few or no holes and hence is optimistic. Note that this formulation does not distinguish between base and wholesale safety stock. It considers only the total, and assumes it will be located so as to do the most good. But only the wholesale stock can be relocated. Each base still has a lower limit on the amount of stock it will have (unless there are wholesale backorders), so support to one user directly from another is not allowed. This is why the variance in the pipeline of an individual base, BVAR, is magnified by the square of the number of users, rather than simply by the number of users itself, in Eq. (B.10a).

Our second approximation to Eq. (B.9) is even easier to obtain. We simply drop the integral portion of Eq. (B.9) and use the term for WBO = 0. That is, we take P(H,i) to be:

$$\text{(B.10b)} \quad P(H,i) = PB(H,i \mid WBO = 0) * PW(WBO = 0, i)$$

We have chosen to use Eq. (B.10b). First, because it underestimates the likelihood that there are few or no holes (and hence overestimates the likelihood that there are many), it should lead to a conservative measure of aircraft availability when used in Eq. (B.5). The use of Eq. (B.10a) would yield an optimistic measure. Second, the use of Eq. (B.10b) allows us to distinguish between base and wholesale safety stock, which is a distinction made in D041. Maintaining this distinction thus keeps our test version of D041 more nearly consistent with the existing execution methodology.

B.4. THE NEED FOR LOWER BOUNDS ON SAFETY LEVELS

We wish to select safety levels that will provide the target aircraft availability at least cost. It would seem, therefore, that the proper formulation of the safety level-problem is:

$$\text{(B.11a)} \quad \begin{cases} \text{Minimize Sum(PRICE(i) * (BSSR(i,y) + WSSR(i,y)) | all i)} \\ \text{s.t.} \quad \text{PC(TFMCS)} \geq \text{TPROB} \end{cases}$$

The variables to be determined are the base and wholesale safety stocks for each item, denoted BSSR and WSSR (for Base Safety Stock Requirement and Wholesale Safety Stock Requirement respectively). These safety stocks affect the expected FMCS aircraft through the probabilities p(h,i) defined earlier. An optimal solution to Problem (B.11a) is a set of base and wholesale safety-stock levels, one for each item, that ensures that the target FMCS aircraft (TFMCS) is met with at least the desired probability (TPROB) at the least possible cost. Note that BSSR and WSSR depend on the year y as well. Problem (B.11a) is solved for each year for which D041 projects requirements, and new safety-level requirements are obtained. In each year, too, the parameters TFMCS and TPROB may be changed, as well as any other parameters involved in Problem (B.11a). Note also that a separate Problem (B.11a) must be solved for each end item--i.e., each weapon system or engine.

Formulation (B.11a), however, has certain drawbacks. One is that it assumes that the cost of increasing a safety level by one item i is always the purchase price of that item, PRICE(i). Depending upon how many of the items are on hand in serviceable or repairable condition, the cost might instead be the depot repair cost, REPCST(i), or even zero. It is relatively easy to modify Formulation (B.11a) to take these possibilities into account, but solving the modified problem requires a more intricate algorithm, which distinguishes many different cases. For simplicity, we ignored this complication in our test version of D041.

The second drawback is more serious. If Problem (B.11a) is solved as it stands, nothing prevents some safety levels from becoming negative. For example, suppose the availability target for a particular aircraft is to have at least 20 aircraft available in each squadron of 24, with a 50 percent probability. Now consider a component with a very low demand rate, so that the expected number in all pipelines is, perhaps, one component, and so that it can be virtually guaranteed that no more then two or three of this component will ever be in pipelines at the same time. Now let every squadron give up three of this component, leaving holes in three aircraft. This amounts to a base safety level of -3 per squadron. By this means we have guaranteed that three aircraft in each squadron will always be missing this component, but its low demand rate ensures that in no squadron will more than four aircraft ever be missing the component.

So long as there are components with low demand rates (such components are in the majority), and so long as the target aircraft availability is not 100 percent, some of the safety levels found by solving Eq. (B.11a) will be negative. Indeed, depending upon anticipated wartime demands for the component, it is possible that the entire component support system could own fewer of the component than it owned aircraft to put them on. (Of course, each aircraft will have all of its components when purchased, but over time, condemnations could reduce the number of a component below the number of aircraft.) The use of Problem (B.11a) to determine safety levels, therefore, may imply that a significant fraction of the fleet cannot ever fly.

To avoid this unpalatable result, we prohibit negative safety levels by placing a lower bound of zero on each one. This guarantees that there will be a sufficient number of each component to fill all holes in aircraft, plus the WRM stockpiles, and to cover the expected peacetime pipeline contents as well. Low demand items that caused such trouble in Problem (B.11a), now cause no trouble; hardly ever will there be a hole in an aircraft or in a WRM stockpile for such an item. The revised problem becomes:

$$
\text{(B.11b)} \quad \left\{ \begin{array}{lll} \text{Minimize} & \text{Sum\{PRICE(i) * (BSSR(i,y) + WSSR(i,y)) |all i\}} & \\ & & \\ \text{c.t.} & \text{PC(TFMCS)} \geq \text{TPROB} & \\ & \text{BSSR(i,y)} \geq 0 & \text{all i} \\ & \text{WSSR(i,y)} \geq 0 & \text{all i} \end{array} \right.
$$

B.5. COMPUTING BASE AND WHOSESALE SAFETY LEVELS

If we ignore the restriction that components must be bought in integer quantities, then an efficient technique for solving Problem (B.11b) can be based on its so-called "Kuhn-Tucker conditions" [10,11]. (Ignoring the integer restriction would be intolerable for management of individual items, but it is, we think, perfectly acceptable if one is interested in aggregate results calculated in terms of dollar values of many components taken together. Hence we have not included an integer restriction in our test version of D041.) It is straightforward, of course, to determine whether a proposed set of safety levels are all nonnegative and to check whether they provide the desired aircraft availability. The Kuhn-Tucker conditions provide a way to determine whether the proposed safety levels meet these conditions at minimum cost. If they do, they constitute an "optimal solution" to Problem (B.11b), and so the Kuhn-Tucker conditions are also refered to as "optionality conditions." For Problem (B.11b), the Kuhn-Tucker conditions state that for each pair of values of TFMCS and TPROB, there will be a value of a new parameter u (called a Lagrange multiplier), that along with the optimal values of BSSR(i,y) and WSSR(i,y) will satisfy:

For each i, if BSSR(i,y) > 0, then:

$$\text{(B.12a)} \quad \text{PRICE}(i) = u * \frac{\text{dPC(TFMCS)}}{\text{dBSSR}(i,y)}$$

For each i, if BSSR(i,y) = 0, then:

$$\text{(B.12b)} \quad \text{PRICE}(i) \geq u * \frac{\text{dPC(TFMCS)}}{\text{dBSSR}(i,y)}$$

For each i, if WSSR(i,y) > 0, then:

$$\text{(B.12c)} \quad \text{PRICE}(i) = u * \frac{\text{dPC(TFMCS)}}{\text{dWSSR}(i,y)}$$

For each i, if WSSR(i,y) = 0, then:

$$\text{(B.12d)} \quad \text{PRICE}(i) \geq u * \frac{\text{dPC(TFMCS)}}{\text{dWSSR}(i,y)}$$

If u > 0, then:

$$\text{(B.12e)} \quad \text{PC(TFMCS)} = \text{TPROB}$$

If u = 0, then:

$$\text{(B.12f)} \quad \text{PC(TFMCS)} \geq \text{TPROB}$$

Note that Conditions (B.12a-f) come in pairs. For each component i, either (B.12a) or (B.12b) must hold, and similarly either (B.12c) or (B.12d) must hold. For the new parameter u, the Lagrange multiplier,

either (B.12e) or (B.12f) must hold. But it will almost always be true that (B.12e), rather than (B.12f), is the operative condition. For if (B.12e) were to hold, then conditions (B.12a) and (B.12b) together imply that for each component i, either the price PRICE(i) or the safety level BSSR(i,y) is zero; and similarly (B.12e) and (B.12d) imply that either PRICE(i) or WSSR(i) is zero. Since no prices are zero, this in turn implies that the target aircraft availability can be achieved with zero safety stock for all components. Accordingly, it will almost always be true that (B.12e) holds and that PC(TFMCS) = TPROB--that is, that the target aircraft availability will be met exactly by the optimal safety levels and not exceeded.

The fact that the expression for PC(TFMCS) can be factored into individual expressions each involving only one item (the P(H,i)) makes the set of Conditions (B.12) relatively easy to solve. We will find it convenient to define the following quantities:

$$b(i,y) = \frac{\dfrac{BSSR(i,y)}{USR(i,y)} + A * QPA(i) * (1 - TFMCS)}{SQRT(BVAR(i,y))}$$

$$w(i,y) = \frac{WSSR(i,y)}{SQRT(WVAR(i,y))}$$

$$g(x) = \frac{f(x)}{F(x)}$$

If we take the derivative of PC(TFMCS) with respect to the base and wholesale safety levels for any item, we find from Eqs. (B.6), (B.8), and (B.10b) that:

$$\text{(B.13a)} \qquad \frac{dPC(TFMCS)}{dBSSR(i,y)} = \frac{PC(TFMCS)}{USR(i,y) * SQRT(BVAR(i,y))} * g(b(i,y))$$

$$\text{(B.13b)} \qquad \frac{dPC(TFMCS)}{dWSSR(i,y)} = \frac{PC(TFMCS)}{SQRT(WVAR(i,y)} * g(w(i,y))$$

Substituting Eqs. (B.13a) and (B.13b) into Conditions (B.11) and rearranging terms, we obtain the following conditions that the optimal safety levels must satisfy.

For each i, if BSSR(i,y) > 0, then:

$$\text{(B.14a)} \quad g(b(i,y)) = \frac{PRICE(i) * USR(i,y) * SQRT(BVAR(i,y))}{u * PC(TFMCS)}$$

For each i, if BSSR(i,y) = 0, then:

$$\text{(B.14b)} \quad g(b(i,y)) \le \frac{PRICE(i) * USR(i,y) * SQRT(BVAR(i,y))}{u * PC(TFMCS)}$$

For each i, if WSSR(i,y) > 0, then:

$$\text{(B.14c)} \quad g(w(i,y)) = \frac{PRICE(i) * SQRT(WVAR(i,y))}{u * PC(TFMCS)}$$

For each i, if WSSR(i,y) = 0, then:

$$\text{(B.14d)} \quad g(W(i,y)) \le \frac{PRICE(i) * SQRT(WVAR(i,y))}{u * PC(TFMCS)}$$

If u > 0, then:

$$\text{(B.14e)} \quad PC(TFMCS) = TPROB$$

If u= 0, then:

$$\text{(B.14f)} \quad PC(TFMCS) \ge TPROB$$

Barring the pair of Conditions (B.14e-f), each of these condition pairs involves only one safety level (wholesale or base) for one item. This is because PC(TFMCS) can be factored into separate expressions for the different safety levels. If PC(TFMCS) were not factorable,

Conditions (B.14a-f) would have to be solved as one single large problem, in which any condition might be affected by a change in any safety level. In our extract from the D041 database, a weapon system may have as many as 1000 items. For such a weapon system, there are 2001 pairs of conditions to consider, 1000 pairs each for the base and wholesale safety levels of each item, and one more pair to ensure that the target FMCS rate is met. If PC(TFMCS) were not factorable, all 2001 of these conditions would have to be considered simultaneously.

We can obtain safety levels for individual items that individually satisfy Condition pairs (B.14a-b) and (B.14c-d), and together satisfy the linking Conditions (B.14e-f), by the following technique. We first select a number of trial values for the product u * PC(TFMCS). As we pass through the list of components, we determine for each of these trial values what values of BSSR(i,y) satisfy (B.14a-b), and what value of WSSR(i,y) satisfies (B.14c-d). From Eq. (B.5) we see that PC(TFMCS) is a product of terms, each of which involves only one component. As we pass through the list of components, we accumulate a partial product of these terms for each of the trial values of u * PC(TFMCS), so that at the end of the pass we have calculated the value of PC(TFMCS). By this method a relation can be mapped out between the value of u and the value of TPROB, and the proper value of u can be selected by interpolation.

The values of BSSR(i,y) and WSSR(i,y) can also be substituted into the cost equation that is minimized in Problem (B.11b), and a relation can be mapped out between cost and the value of u. The two relations can be combined to determine a relation between cost and aircraft availability that can be read two ways. For any given availability, it will give the smallest dollar value of safety stock needed to achieve it; and for any amount of money, it will give the greatest aircraft availability that could be achieved by investing that money in safety stock.

We note that this solution technique requires that two passes be made through the list of items. In the first pass, the safety levels for several values of u may be calculated, and the value of PC(TFMCS) and of the total cost of the items can be built up for each value of u. By interpolation among the values of PC(TFMCS), the value of u may be found that will yield the correct value for TPROB. Then, one must pass

through the items a second time, using the correct value of u to recalculate the safety levels for each item.

We also note that, as mentioned earlier, a separate Problem (B.11b) must be solved for each weapon system or engine--i.e., each end item. In addition, the inventory of aircraft and the hours they fly will change from year to year, so for each end item a separate Problem (B.11b) must be solved for each year of the D041 projection. Thus, there will be a different u for each end item and year.

LIST OF VARIABLE NAMES

a(k) Percentage of end items k lost per sortie during a wartime scenario (Sec. 4.6.2).

A(k) Number of end items k possessed by each user in peacetime (Sec. 4.5.1).

A(k,t) Number of end items k possessed by each user at time t in a wartime scenario (Sec. 4.6.2).

ABREP(i,y) Number of components i that can be repaired at base level and applied against the requirement for component i in year y (Eq. (73), Sec. 4.9.1).

ABREPD(k,y) Dollar value of components belonging to end item k that can be repaired at base level and applied against requirements in year y (Eq. (81b), Sec. 4.9.2).

ADREP(i,y) Number of components i that can be repaired at depot level and applied against the requirement for component i in year y (Eq. (76), Sec. 4.9.1).

ADREPD(k,y) Dollar value of components belonging to end item k that can be repaired at depot level and applied against requirements in year y (Eq. (82b), Sec. 4.9.2).

ALT(i) Administrative lead time months for component i (Table 1, Sec. 4.3).

b(i,y) Intermediate variable related to BSSR(i,y) (Sec. 4.5.1).

B'(i,y) Compact notation for a derivative of the potential base repairs of component i in year y, PBREP(i,y) (Sec. 4.9.2).

BACKLOG(i) Number of components i currently in backlog at the depot (Sec. 4.9.1).

BMEAN(i,y) Expected number per user of components i in either the base repair pipeline or the order-and-ship pipeline from wholesale to base in year y (Sec. 4.5.1).

BOSR(i,y) Expected number of components i in the order-and-ship pipeline from wholesale to base in year y (Eq. (5), Sec. 4.4.1).

BOSRD(y) Dollar value of all components in the order-and-ship pipeline from wholesale to base in year y (Eq. (20), Sec. 4.4.2).

BOSTD(i)	Base order-and-ship days for component i (Table 1, Sec. 4.3).
BRCD(i)	Base repair cycle days for component i (Table 1, Sec. 4.3).
BRCR(i,y)	Expected number of components i in the base repair cycle pipeline in year y (Eq. (6), Sec. 4.4.1).
BRHS	Intermediate variable, used in obtaining expressions for derivatives of base OIM safety-level requirements (Sec. 4.5.2).
BSSR(i,y)	Base OIM safety-stock requirement for component i in year y (Sec. 4.5.1).
BSSRD(k,y)	Dollar value of year y base safety-level requirements for all components applied to end item k (Eq. (33), Sec. 4.5.3).
BUY1(k,y)	Dollar value of components belonging to end item k with total procurement lead times less than one year that must be bought (and received) by year y to satisfy the requirement (Eq. (86a), Sec. 4.9.2).
BUY2(k,y)	Dollar value of components belonging to end item k with total procurement lead times between one and two years that must be bought (and received) by year y to satisfy the requirement (Eq. (86b), Sec. 4.9.2).
BUY3(k,y)	Dollar value of components belonging to end item k with total procurement lead times between two and three years that must be bought (and received) by year y to satisfy the requirement (Eq. (86c), Sec. 4.9.2).
BVAR(i,y)	Variance of the number per user of components i in the base repair pipeline plus the order-and-ship pipeline from wholesale to base in year y (Sec. 4.5.1).
CB1(i,y)	First coefficient in the expression for the derivative of the base OIM safety-stock requirement for component i in year y (Eqs. (27a) and (28a), Sec. 4.5.2).
CB2(i,y)	Second coefficient in the expression for the derivative of the base OIM safety-stock requirement for component i in year y (Eqs. (27a) and (28a), Sec. 4.5.2).
CB3(i,y)	Third coefficient in the expression for the derivative of the base OIM safety-stock requirement for component i in year y (Eqs. (27a) and (28a), Sec. 4.5.2).

CB4(i,y)	First coefficient related to the base OIM safety-level requirement for component i in year y in the expression for the derivative of the Lagrange multiplier u(k,y) (Eqs. (32a), (32b), and (28e), Sec. 4.5.2).
CB5(i,y)	Second coefficient related to the base OIM safety-level requirement for component i in year y in the expression for the derivative of the Lagrange multiplier u(k,y) (Eqs. (32a), (32b), and (28e), Sec. 4.5.2).
CB6(i,y)	Third coefficient related to the base OIM safety-level requirement for component i in year y in the expression for the derivative of the Lagrange multiplier u(k,y) (Eqs. (32a), (32b), and (28e), Sec. 4.5.2).
CBD1(k,y)	First coefficient in the expression for the derivative of the dollar requirement for base OIM safety stock for end item k in year y (Eq. (35a), Sec. 4.5.2).
CBD2(k,y)	Second coefficient in the expression for the derivative of the dollar requirement for base OIM safety stock for end item k in year y (Eq. (35a), Sec. 4.5.2).
CBD3(k,y)	Third coefficient in the expression for the derivative of the dollar requirement for base OIM safety stock for end item k in year y (Eq. (35a), Sec. 4.5.2).
CD4(k,y)	First coefficient aggregated over all components applied to end item k in year y in the expression for the derivative of the Lagrange multiplier u(k,y) (Eq. (36), Sec. 4.5.3).
CD5(k,y)	Second coefficient aggregated over all components applied to end item k in year y in the expression for the derivative of the Lagrange multiplier u(k,y) (Eq. (36), Sec. 4.5.3).
CD6(k,y)	Third coefficient aggregated over all components applied to end item k in year y in the expression for the derivative of the Lagrange multiplier u(k,y) (Eq. (36), Sec. 4.5.3).
CEOPR(k,y)	Cumulative number of engine overhauls programmed for end item k through year y (Eq. (9a), Sec. 4.4.1).
CEPIT(i,y)	Cumulative number of components i programmed to pass through engine overhaul (as parts on various end items) through year k (Eq. (9b), Sec. 4.4.1).
CFAILS(i,t)	Cumulative failures of a component i through time t in a wartime scenario for a single user (Sec. 4.6.4).

CH(k,t)	Flying hours accumulated by one user's end items k through time t of a wartime scenario (Sec. 4.6.2).
CNDB(i)	Base condemnation percentage of component i (Table 1, Sec. 4.3).
CNDJE(i)	EOH job-routed condemnation percentage for component i (Table 1, Sec. 4.3).
CNDJP(i)	PDM job-routed condemnation percentage for component i (Table 1, Sec. 4.3).
COIPR(k,y)	Cumulative flying hours programmed for end item k through year k (Eq. (1a), Sec. 4.4.1).
COPIT(i,y)	Cumulative flying hours programmed for component i through year k (Eq. (1b), Sec. 4.4.1).
CP1(i)	First coefficient in the expression for the derivative of the PWRM requirement of a single user of component i (Eqs. (49a) and (50a), Sec. 4.6.5).
CP2(i)	Second coefficient in the expression for the derivative of the PWRM requirement of a single user of component i (Eqs. (49a) and (50a), Sec. 4.6.5).
CP3(i)	Third coefficient in the expression for the derivative of the PWRM requirement of a single user of component i (Eqs. (49a) and (50a), Sec. 4.6.5).
CP4(i)	First coefficient related to the PWRM requirement of a single user for component i in the expression for the derivative of the Lagrange multiplier u(k) (Eqs. (52a), (52b), and (50c), Sec. 4.6.5).
CP5(i)	Second coefficient related to the PWRM requirement of a single user for component i in the expression for the derivative of the Lagrange multiplier u(k) (Eqs. (52a), (52b), and (50c), Sec. 4.6.5).
CP6(i)	Third coefficient related to the PWRM requirement of a single user for component i in the expression for the derivative of the Lagrange multiplier u(k) (Eqs. (52a), (52b), and (50c), Sec. 4.6.5).
CPDPR(k,y)	Cumulative number of PDMs programmed for end item k through year y (Eq. (8a), Sec. 4.4.1).
CPPIT(i,y)	Cumulative number of components i programmed to pass through PDMs (as parts on various end items) through year k (Eq. (8b), Sec. 4.4.1).

CPW1(i)	First coefficient in the expression for the derivative of the WRSK requirement of a single user of component i (Sec. 4.6.7).
CPW2(i)	Second coefficient in the expression for the derivative of the WRSK requirement of a single user of component i (Sec. 4.6.7).
CPW3(i)	Third coefficient in the expression for the derivative of the WRSK requirement of a single user of component i (Sec. 4.6.7).
CPW4(i)	First coefficient related to the (WRSK) requirement of a single user for component i, in the expression for the derivative of the Lagrange multiplier u(k) (Sec. 4.6.7).
CPW5(i)	Second coefficient related to the WRSK requirement of a single user for component i in the expression for the derivative of the Lagrange multiplier u(k) (Sec. 4.6.7).
CPW6(i)	Third coefficient related to the WRSK requirement of a single user for component i in the expression for the derivative of the Lagrange multiplier u(k) (Sec. 4.6.7).
CPWD1(k)	First coefficient in the expression for the derivative of the dollar requirement for the WRSK of a single user of end item k (Eq. (62a), Sec. 4.6.7).
CPWD2a(k)	Second coefficient in the expression for the derivative of the dollar requirement for the WRSK of a single user of end item k (Eq. (62a), Sec. 4.6.7).
CPWD2b(k)	Third coefficient in the expression for the derivative of the dollar requirement for the WRSK of a single user of end item k (Eq. (62a), Sec. 4.6.7).
CPWD2c(K)	Fourth coefficient in the expression for the derivative of the dollar requirement for the WRSK of a single user of end item k (Eq. (62a), Sec. 4.6.7).
CPWD2d(k)	Fifth coefficient in the expression for the derivative of the dollar requirement for the WRSK of a single user of end item k (Eq. (62a), Sec. 4.6.7).

CPWD2e(k)	Sixth coefficient in the expression for the derivative of the dollar requirement for the WRSK of a single user of end item k (Eq. (62a), Sec. 4.6.7).
CPWD3(k)	Seventh coefficient in the expression for the derivative of the dollar requirement for the WRSK of a single user of end item k (Eq. (62a), Sec. 4.6.7).
CPWD4(k)	First coefficient aggregated over all components in a WRSK for a single user of end item k in the expression for the derivative of the Lagrange multiplier u(k) (Eq. (62c), Sec. 4.6.7).
CPWD5a(k)	Second coefficient aggregated over all components in a WRSK for a single user of end item k in the expression for the derivative of the Lagrange multiplier u(k) (Eq. (62c), Sec. 4.6.7).
CPWD5b(k)	Third coefficient aggregated over all components in a WRSK for a single user of end item k in the expression for the derivative of the Lagrange multiplier u(k) (Eq. (62c), Sec. 4.6.7).
CPWD5c(k)	Fourth coefficient aggregated over all components in a WRSK for a single user of end item k in the expression for the derivative of the Lagrange multiplier u(k) (Eq. (62c), Sec. 4.6.7).
CPWD5d(k)	Fifth coefficient aggregated over all components in a WRSK for a single user of end item k in the expression for the derivative of the Lagrange multiplier u(k) (Eq. (62c), Sec. 4.6.7).
CPWD5e(k)	Sixth coefficient aggregated over all components in a WRSK for a single user of end item k in the expression for the derivative of the Lagrange multiplier u(k) (Eq. (62c), Sec. 4.6.7).
CPWD6(k)	Seventh coefficient aggregated over all components in a WRSK for a single user of end item k in the expression for the derivative of the Lagrange multiplier u(k) (Eq. (62c), Sec. 4.6.7).
CREPS(i,t)	Maximum potential cumulative repairs of component i through time t in a wartime scenario for a single user (Sec. 4.6.4).
CW1(i,y)	First coefficient in the expression for the derivative of the wholesale OIM safety-stock requirement for component i in year y (Eqs. (27c) and (28c), Sec. 4.5.2).

CW2(i,y) Second coefficient in the expression for the derivative of the wholesale OIM safety-stock requirement for component i in year y (Eqs. (27c) and (28c), Sec. 4.5.2).

CW3(i,y) Third coefficient in the expression for the derivative of the wholesale OIM safety-stock requirement for component i in year y (Eqs. (27c) and (28c), Sec. 4.5.2).

CW4(i,y) First coefficient related to the wholesale OIM safety-level requirement for component i in year y in the expression for the derivative of the Lagrange multiplier u(k,y) (Eqs. (32c), (32d), and (28e), Sec. 4.5.2).

CW5(i,y) Second coefficient related to the wholesale OIM safety-level requirement for component i in year y in the expression for the derivative of the Lagrange multiplier u(k,y) (Eqs. (32c), (32d), and (28e), Sec. 4.5.2).

CW6(i,y) Third coefficient related to the wholesale OIM safety-level requirement for component i in year y in the expression for the derivative of the Lagrange multiplier u(k,y) (Eqs. (32c), (32d), and (28e), Sec. 4.5.2).

CWD1(k,y) First coefficient in the expression for the derivative of the dollar requirement for wholesale OIM safety-stock requirement for end item k in year y (Eq. (35b), Sec. 4.5.2).

CWD2(k,y) Second coefficient in the expression for the derivative of the dollar requirement for wholesale OIM safety-stock requirement for end item k in year y (Eq. (35b), Sec. 4.5.2).

CWD3(k,y) Third coefficient in the expression for the derivative of the dollar requirement for wholesale OIM safety-stock requirement for end item k in year y (Eq. (35b), Sec. 4.5.2).

D'(i,y) Compact notation for a derivative of the potential depot repairs of component i in year y, PDREP(i,y) (Sec. 4.9.2).

DFLSL(i) Depot floating-stock-level requirement for component i (Sec. 4.8).

DIAPL(i,y) Number of due in or on order components i that can be applied against the total gross requirement in year y (Eq. (78), Sec. 4.9.1).

DIAPLD(k,y) Dollar value of components belonging to end item k that are currently due in or on order and can be applied against requirements in year y (Eq. (85b), Sec. 4.9.2).

DORCR(i,y)	Expected number of components i in the depot repair cycle pipeline due to OIM activities in year y (Eq. (7), Sec. 4.4.1).
DPEM(k,y)	Repair cost of components belonging to end item k that can be repaired at depot level and applied against requirements in year y (Eq. (83), Sec. 4.9.2).
DUEIN(i)	Number of components i currently on order from the contractor or due in from other sources (Sec. 4.9.1).
EJOR(i,y)	Cumulative EOH job-routed operating requirement for component i through year k (Eq. (15), Sec. 4.4.1).
EJSR(i,y)	EOH job-routed stock-level requirement for component i through year k (Eq. (17), Sec. 4.4.1).
Emax(i)	Maximum expected amount of stock of component i required by a single user at any time in a wartime scenario before resupply from the wholesale echelon is available (Sec. 4.6.4).
ENOR(i,y)	Cumulative EOH nonjob-routed operating requirement for component i through year k (Eq. (14), Sec. 4.4.1).
ENSR(i,y)	EOH nonjob-routed stock-level requirement for component i through year k (Eq. (16), Sec. 4.4.1).
EOHPG(k,y)	Number of engine overhauls programmed for end item k in year y (Sec. 4.4.1).
f(x)	Probability density function for the Normal distribution with zero mean and unit variance (Sec. 4.5.1).
F(x)	Cumulative distribution function for the Normal distribution with zero mean and unit variance (Sec. 4.5.1).
FACT1(i)	Intermediate variable relating to derivatives of PWRM requirements (Sec. 4.6.6).
FACT2(i)	Intermediate variable relating to derivatives of PWRM requirements (Sec. 4.6.6).
g(x)	Ratio of the Normal density function to the cumulative Normal distribution function (Sec. 4.5.1).
JRSLD(i)	Job-routed stock-level days for component i (Table 1, Sec. 4.3).
L(k)	Length in hours of a sortie by end item k (Sec. 4.6.2).

NEGSL(i)	Negotiated base stock-level requirement for component i (Sec. 4.8).
NJRSLD(i)	Nonjob-routed stock-level days for component i (Table 1, Sec. 4.3).
OADD(i)	Other additive requirements for component i (Sec. 4.8).
OIMBRR(i)	OIM base repairs per flying hour of component i (Table 1, Sec. 4.3).
OIMDDR(i)	OIM depot demands per flying hour of component i (Table 1, Sec. 4.3).
OIMPG(k,y)	Flying hours programmed for end item k in year y (Sec. 4.4.1).
OIOPR(i,y)	Cumulative total OIM demands for component i through year y (Eq. (2), Sec. 4.4.1).
OSRATE(i)	Number of components i per flying hour that are requisitioned from the wholesale echelon (Sec. 4.4.1).
OSTF(k)	Dollar value of components expected to be in the order-and-ship pipeline from wholesale to base per flying hour of end item k (Eq. (21), Sec. 4.4.2).
OVER1(i,y)	Number of serviceable components i that cannot be applied against the total gross requirement in year y (Eq. (72a), Sec. 4.9.1).
OVER2(i,y)	Number of components i that are repairable at base level but cannot be applied against the total gross requirement in year y (Eq. (74a), Sec. 4.9.1).
OVER4(i,y)	Number of components i that are repairable at depot level but cannot be applied against the total gross requirement in year y (Eq. (77a), Sec. 4.9.1).
OVER6(i,y)	Number of due in or on order components i that cannot be applied against the total gross requirement in year y Eq. (79a), Sec. 4.9.1).
OWRM(i)	OWRM requirement for component i (Sec. 4.8).
PBREP(i,y)	Cumulative potential base repairs of component i through year y (Eq. (3), Sec. 4.4.1).
PC(TFMCS,k)	Probability of meeting the target FMCS fraction for end item k under full cannibalization (Sec. 4.5.1).

PDDREP(i,y) Cumulative potential depot repairs of PDM failures of component i through year y (Eq. (18), Sec. 4.4.1).

PDMPG(k,y) Number of PDMs programmed for end item k in year y (Sec. 4.4.1).

PDREP(i,y) Number of components i that can potentially be repaired at the depot, including repairable components from all sources (Eq. (75), Sec. 4.9.1).

PEDREP(i,y) Cumulative potential depot repairs of EOH failures of component i through year y (Eq. (19), Sec. 4.4.1).

PJOR(i,y) Cumulative PDM job-routed operating requirement for component i through year k (Eq. (11), Sec. 4.4.1).

PJSR(i,y) PDM job-routed stock-level requirement for component i through year k (Eq. (13), Sec. 4.4.1).

PLT(i) Production lead time months for component i (Table 1, Sec. 4.3).

PNOR(i,y) Cumulative PDM nonjob-routed operating requirement for component i through year k (Eq. (10), Sec. 4.4.1).

PNSR(i,y) PDM nonjob-routed stock-level requirement for component i through year k (Eq. (12), Sec. 4.4.1).

PODREP(i,y) Cumulative potential depot repairs of OIM failures of component i through year y (Eq. (4), Sec 4.4.1).

PRICE(i) Unit purchase price of component i (Table 1, Sec. 4.3).

PWRM(i,y) Total PWRM requirement for all users of component i in year y (Eq. (58), Sec. 4.6.7).

PWRMD(k,y) Dollar value of PWRM requirements for end item k in year y (Eq. (59), Sec. 4.6.7).

QPA(i,k) Average number of components i applied per end item k (Sec. 4.4.1).

r(i) Intermediate variable related to WRES(i) (Sec. 4.6.4).

R(i) Time in a wartime scenario at which repair first becomes available for component i (Sec. 4.6.2).

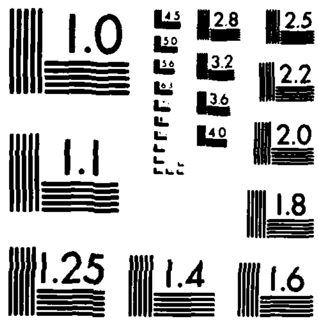
REPCST(i) Unit cost of repairing component i at the depot (Table 1, Sec. 4.3).

REPNE(i) EOH nonjob-routed repair percentage for component i (Table 1, Sec. 4.4).

AD-A152 014 MANAGING RECOVERABLE AIRCRAFT COMPONENTS IN THE PPB (PLANNING PROGRAMMING..(U) RAND CORP SANTA MONICA CA J BIGELOW JUN 84 RAND/R-3094-MIL MDA903-81-C-0381 5/5

UNCLASSIFIED F/G 5/1 NL

END
FILMED
DTIC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

REPNP(i) PDM nonjob-routed repair percentage for component i (Table 1, Sec. 4.3).

RHS Intermediate variable, used in obtaining expressions for derivatives of PWRM requirements (Sec. 4.6.5).

RPLNE(i) EOH nonjob-routed replacement percentage for component i (Table 1, Sec. 4.3).

RPLNP(i) PDM nonjob-routed replacement percentage for component i (Table 1, Sec. 4.3).

S(k) Sorties per day per possessed end item k in wartime (Sec. 4.6.2).

SHORT1(i,y) Requirement of component i that remains in year y after all possible serviceable components have been applied (Eq. (72b), Sec. 4.9.1).

SHORT2(i,y) Requirement of component i that remains in year y after all possible serviceable and base repairable components have been applied (Eq. (74b), Sec. 4.9.1).

SHORT4(i,y) Requirement of component i that remains in year y after all possible serviceable, base repairable, and depot repairable components have been applied (Eq. (77b), Sec. 4.9.1).

SHORT6(i,y) Requirement of component i that remains in year y after all possible serviceable, base repairable, depot repairable, and due in or on order components have been applied (Eq. (79b), Sec. 4.9.1).

SVAPL(i,y) Number of serviceable components i that can be applied against the total gross requirement in year y (Eq. (71), Sec. 4.9.1).

SVAPLD(k,y) Dollar value of components belonging to end item k that are currently serviceable and can be applied against requirements in year y (Eq. (80b), Sec. 4.9.2).

SVCBL(i) Number of components i currently available in serviceable condition (Sec. 4.9.1).

T'(i,y) Compact notation for a derivative of the total gross requirement of component i in year y, TGIR(i,y) (Sec. 4.9.2).

TDRCD(i) Total depot repair cycle days for component i (Table 1, Sec. 4.3).

TFMCS(k)	A goal set for the fraction of end items k that a user must have FMCS (Sec. 4.5.1 for peacetime, Sec. 4.6.4 for wartime).
TGIR(i,y)	Total gross requirement for component i in year y (Eq. (70), Sec. 4.8).
TLT(i)	Total procurement lead time for component i, consisting of administrative plus production lead times (Sec. 4.9.2).
Tmax(i)	Time in a wartime scenario at which the maximim expected requirement for stocks of component i occurs (Sec. 4.6.4).
TOIMDR(i)	Total OIM demands per flying hour of component i (Table 1, Sec. 4.3).
TPROB(k)	Probability of meeting the FMCS goal for end item k, TFMCS(k) (Sec. 4.5.1 for peacetime, Sec. 4.6.4 for wartime).
TSUP(k)	Time in a wartime scenario at which resupply from the wholesale echelon is first available (Sec. 4.6.2).
u(k)	Lagrange multiplier associated with the availability constraint for end item k in the problem one must solve to determine PWRM requirements for a single user of end item k (Sec. 4.6.4).
u(k,y)	Lagrange multiplier associated with the availability constraint for end item k in year y in the problem one must solve to determine peacetime OIM safety-level requirements (Sec. 4.5.1).
UBL(k,y)	Number of users of base-level spares support (BLSS) for end item k in year y. BLSS is a PWRM allotment calculated assuming that the normal base-level repair capability is available to the user throughout the wartime scenario (Sec. 4.6.7).
USR(i,y)	Number of peacetime users of component i in year y, each of whom receives one allotment of base OIM safety stock (Sec. 4.5.1).
UWR(k,y)	Number of users of WRSK for end item k in year y. WRSK is a PWRM allotment calculated assuming that only limited repair is available to the user before resupply from the wholesale echelon becomes available (Sec. 4.6.7).
Vmax(i)	Variance in the maximum amount of stock of component i required by a single user at any time in a wartime scenario before resupply from the wholesale echelon is available (Sec. 4.6.4).

VTMR	Variance to mean ratio, assumed to be the same for all components in all pipelines, in peacetime and wartime (Sec. 4.5.1 for peacetime, Sec. 4.6.4 for wartime).
w(i,y)	Intermediate variable related to WSSR(i,y) (Sec. 4.5.1).
WMEAN(i,y)	Expected number of components i in the depot repair pipeline due to OIM activity in year y (Sec. 4.5.1).
WRES(i)	Amount of stock of component i required by a single user as PWRM stock (Sec. 4.6.4).
WRESB(i)	Amount of stock of component i required by a single user of BLSS (Sec. 4.6.4).
WRESBD(k)	Dollar value of BLSS for a single user of end item k.
WRESW(i)	Amount of stock of component i required by a single user of a WRSK (Sec. 4.6.4).
WRESWD(k)	Dollar value of the WRSK for a single user of end item k.
WRHS	Intermediate variable, used in obtaining expressions for derivatives of wholesale OIM safety-level requirements (Sec. 4.5.2).
WSSR(i,y)	Wholesale OIM safety-stock requirement for component i in year y (Sec. 4.5.1).
WSSRD(k,y)	Dollar value of year y wholesale safety-level requirements for all components applied to end item k (Eq. (33), Sec. 4.5.3).
WVAR(i,y)	Variance of the number of components i in the depot repair pipeline due to OIM activity in year y (Sec. 4.5.1).

REFERENCES

1. Air Force Logistics Command, *Recoverable Consumption Item Requirements System (D041)*, AFLC Regulation 57-4, February 1980.

2. Department of Defense, *Requirements Priority and Asset Application for Secondary Items*, DoD Instruction 4140.24.

3. Department of Defense, *Leadtime Computation, Demand Forecasting, Activity Stocking Criteria, and Levels Computations*, Washington, D.C., Revised January 1983.

4. Department of Defense, *Functional Description for UICP Application B, Operation 20 (Stratification)*, Mechanicsburg, PA, revised November 1982.

5. Hillestad, R. J., *Dyna-METRIC: Dynamic Multi-Echelon Technique for Recoverable Item Control*, The Rand Corporation, R-2785-AF, July 1982.

6. Exercise Improvement Team, *Improving the Air Force Planning, Programming and Budgeting System Exercise Process*, (2 volumes). The Pentagon, June 1982.

7. Director of Budget, Headquarters USAF *USAF Force and Financial Plan* (published three times yearly).

8. O'Malley, T. J., *The Aircraft Availability Model: Conceptual Framework and Mathematics*, Logistics Management Institute, Washington, D.C., June 1983.

9. Colvin, T., et al., *The Capabilities and Logic of the Logistics Capability Measurement System (LCMS) Overview Model: Final Report*, Synergy Inc., Washington, D.C., May 1979.

10. Kuhn, H. W., and A. W. Tucker, "Nonlinear Programming," in J. Newman (ed.), *Proceedings of the 2nd Berkeley Symposium on Mathematics, Statistics and Probability*, University of California, Berkeley, 1950, pp. 481-492.

11. Hillier, F. S., and G. J. Lieberman, *Introduction to Operations Research*, 3rd ed., Holden Day, Inc., San Francisco, 1980, pp. 748-751.

12. Bigelow, J. H., and N. Z. Shapiro, "Implicit Function Theorems for Mathematical Programming and for Systems of Inequalities," *Mathematical Programming*, Vol. 6, No. 2, pp. 141-156, April 1974.

13. Bigelow, J. H., and K. Isaacson, *Models To Assess the Peacetime Material Readiness and Wartime Sustainability of U.S. Air Forces: A Progress Report*, The Rand Corporation, N-1896-MRAL, October 1982.

END

FILMED

5-85

DTIC